INVESTIGATION OF CONCENTRATION OF ECONOMIC POWER

HEARINGS

BEFORE THE

TEMPORARY NATIONAL ECONOMIC COMMITTEE CONGRESS OF THE UNITED STATES

SEVENTY-SIXTH CONGRESS

THIRD SESSION

PURSUANT TO

Public Resolution No. 113

(Seventy-fifth Congress)

AUTHORIZING AND DIRECTING A SELECT COMMITTEE TO MAKE A FULL AND COMPLETE STUDY AND INVESTIGATION WITH RESPECT TO THE CONCENTRATION OF ECONOMIC POWER IN, AND FINANCIAL CONTROL OVER, PRODUCTION AND DISTRIBUTION OF GOODS AND SERVICES

PART 26

IRON AND STEEL INDUSTRY

UNITED STATES STEEL CORPORATION STUDIES

PRICES AND COSTS

JANUARY 23, 24, AND 25, 1940

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INVESTIGATION OF CONCENTRATION OF ECONOMIC POWER

TUESDAY, JANUARY 23, 1940

UNITED STATES SENATE,
TEMPORARY NATIONAL ECONOMIC COMMITTEE,
Washington, D. C.

The committee met at 10:35 a. m., pursuant to call of the chairman, in the Caucus Room, Senate Office Building, Senator William H. King, Utah, presiding.

Present: Senator King (acting chairman); Messrs. Hinrichs, O'Connell, and Brackett.

Present also: Willis Ballinger and Walter B. Wooden, representing the Federal Trade Commission; John V. W. Reynders, representing the Department of Commerce; A. H. Feller, representing the Department of Justice; Dr. Theodore J. Kreps, economic adviser to the committee.

Acting Chairman KING. Dr. Kreps, are you ready to proceed?

Dr. KREPS. Yes, sir.

Acting Chairman KING. Mr. Fairless, come forward, please. You were sworn here before as a witness. You may proceed, Dr. Kreps.

TESTIMONY OF BENJAMIN F. FAIRLESS, PRESIDENT, UNITED STATES STEEL CORPORATION, NEW YORK CITY

Dr. KREPS. Mr. Fairless, will you make your statement, please?

Mr. FAIRLESS. Mr. Chairman, at the hearing held on November 8, 1939, I submitted to the committee certain charts and pamphlets which were marked "Exhibits Nos. 1409 to 1418," inclusive.[1] I am informed that these exhibits may now form a part of the record of the committee, and, accordingly, I offer these exhibits for that purpose, together with 3 additional pamphlets and 13 additional charts, which have been heretofore given to Dr. Kreps.

("Exhibits Nos. 1409 to 1417," inclusive, are included in the appendix on pp. 13743–14082. "Exhibit No. 1418" appears in Hearings, Part 27, appendix, p. 14[illegible]19.)

These additional pamphlets are entitled "The Distribution of Steel to Major Consuming Industries," "Indexes of Mill-Net Yields on Products Shipped by United States Steel Corporation Subsidiaries," and "Improved Quality of Steel as a Price Reduction." The 13 additional charts should be included in the book of charts, designated as "Exhibit No. 1409." [2]

Dr. KREPS. Mr. Chairman, I suggest that these exhibits be placed into the record as indicated by Mr. Fairless.

[1] See Hearings, Part 20, p. 10803.
[2] The 13 additional charts are included in "Exhibit No. 1409," appendix, p. 13743.

Acting Chairman KING. They may be so received and placed in the record.

(The three pamphlets referred to were marked "Exhibits Nos. 2080, 2181, and 2182," respeotively, and are included in the appendix on pp. 14095, 14101 and 14109.)

Mr. FAIRLESS. I should like, Mr. Chairman, to say a few words about these various pamphlets and charts which have been submitted to the committee by the Steel Corporation. From the outset, we have understood that it was the purpose of the T. N. E. C. to obtain the material facts about the steel industry as a part of the committee's objective inquiry into American business. The Steel Corporation has tried to the best of its ability to cooperate with the committee to this end. Accordingly, we organized a special T. N. E. C. group, consisting of 30 or more individuals. Some were employees of the Corporation; some were economists and graduate students in economics employed by the Corporation for this purpose; and some were lawyers assigned to this work by Governor Miller and Mr. Olds, two of our directors, from their respective law offices. This group over a period of more than a year and a half has conducted various studies, the results of which are contained in these papers. The work, of an economic nature, was under the direction of Dr. Theodore O. Yntema, of the University of Chicago, who is here today and is prepared to explain to the committee the various studies made under his direction.

On behalf of the United States Steel Corporation, I should like to express our appreciation of your admission into the record of these various papers, which I hope will be of aid to the committee in its consideration of the topics discussed therein.

Mr. BALLINGER. Mr. Chairman, could the Federal Trade Commission make the request that the pamphlet on the basing-point system [1] not be released to the press until our reply to it accompanies it? [2]

Acting Chairman KING. What are your views about that, Dr. Kreps?

Dr. KREPS. I think that would be fair.

Acting Chairman KING. Do you have any objection to that, Mr. Fairless?

Mr. FAIRLESS. No objection.

Acting Chairman KING. Granted.

Dr. KREPS. That is all. Mr. Fairless will be called back later in the hearing.

Acting Chairman KING. The committee may not be able to read those records during this hearing, I mean today, but I think we shall before we conclude our labors.

Dr. KREPS. These have all been submitted to the members of the committee as well as to the members of the staff.

I would like next to call Prof. Theodore Otte Yntema to take the stand.

Acting Chairman KING. Doctor, will you come forward? Will you hold up your right hand and be sworn?

Do you solemnly swear that the testimony you will give in this hearing shall be the truth, the whole truth, and nothing but the truth, so help you God?

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[1] "Exhibit No. 1418."

[2] Mr. Ballinger refers to "An Analysis of the Basing Point System of Delivered Prices as Presented by United States Steel Corporation in 'Exhibits Nos. 1410 and 1418' by Walter B. Wooden, Assistant Chief Counsel, and Hugh E. White, Examiner Federal Trade Commission," admitted to the record as "Exhibit No. 2242" and appearing in Hearings, Part 27.

Dr. YNTEMA. I do.
Acting Chairman KING. You may proceed.

TESTIMONY OF DR. THEODORE OTTE YNTEMA, PROFESSOR OF STATISTICS, UNIVERSITY OF CHICAGO, CHICAGO, ILL.

Dr. KREPS. Dr. Yntema, for the purpose of the record, will you state your full name and address, please?

Dr. YNTEMA. My name is Theodore Otte Yntema. My address is 1154 East Fifty-sixth Street, Chicago, Ill.

Dr. KREPS. You are professor of statistics in the School of Business of the University of Chicago, is that correct?

Dr. YNTEMA. That is correct.

Dr. KREPS. And director of research in the Cowles Commission for Research in Economics, an institution affiliated with the University of Chicago?

Dr. YNTEMA. That is correct.

Dr. KREPS. You are also a certified public accountant?

Dr. YNTEMA. That is correct.

Dr. KREPS. You have taught accounting for several years at the University of Chicago?

Dr. YNTEMA. Yes.

Dr. KREPS. Since what period have you been associated with the United States Steel Corporation as a consulting economist?

Dr. YNTEMA. Since July 1938.

Dr. KREPS. How much of your time have you devoted to the studies which have been submitted here by Mr. Fairless?

Dr. YNTEMA. I have devoted over half of my time to the preparation of these studies.

Dr. KREPS. Have you had assistance?

Dr. YNTEMA. Yes. Under my supervision I had a special research section, consisting of economists, graduate students and others.

Dr. KREPS. A number of these had already made intensive studies of the steel industry before they worked on your staff?

Dr. YNTEMA. One of these members had.

Dr. KREPS. I believe you have a brief summary of your analysis which you would like to present to the committee entitled "Factors Affecting the Demand for Steel and the Relation of Steel Prices to Costs"?

Dr. YNTEMA. That is correct.

Dr. KREPS. You may proceed.

Acting Chairman KING. Proceed, Doctor.

SUMMARY OF UNITED STATES STEEL CORPORATION STUDIES

Dr. YNTEMA. In summarizing these studies, it will be necessary for me to pass over many interesting and important details, to confine myself to a rather cursory statement of the facts and the inferences to be drawn from them, and to omit at many points the qualifications which would be desirable if there were time for them.

This committee has evidenced a deep interest in the relation of steel prices to production and employment in the steel industry. Recognizing the importance of this problem and the committee's interest in it, the United States Steel Corporation has prepared and

submitted to the committee a number of studies dealing with this subject. It is our hope that the members of the committee may find them helpful in their deliberations. We welcome criticism of these studies and hope that out of the discussion there may come a better understanding of the important problems to which they relate.

These studies do not, of course, answer all the questions relating to price flexibility in durable goods, but they do, we believe, present factual evidence illuminating some aspects of the problem.

The basic questions to which our studies were addressed are these:

1. To what extent will the production and sale of steel respond to changes in the price of steel?

2. To what extent do costs vary with volume of production?

3. How far, if at all, is it feasible for the steel industry to achieve additional sales, production and employment in depression by reduction of prices?

In other words, is it possible for the steel industry to achieve fuller utilization of its productive facilities and thus greater employment by means of price reductions in periods of low demand?

An analysis of the evidence available to us leads to these conclusions:

1. The quantity of steel that can be sold is relatively unresponsive to changes in the level of steel prices. In other words, the demand for steel is inelastic. A reduction in the price of steel, therefore, will bring only a small increase in its consumption. The fluctuations in the production of steel have been due primarily to shifts in demand caused by changes in general business activity, consumers' income and industrial profits. In comparison with these factors, the price of steel has been a minor influence on the quantity of steel sold.

2. The reduction in average costs resulting from increased output is much less than the reduction in prices which is necessary to induce such increase in output. All but a small percentage of the costs of producing steel, in good times and bad, are out-of-pocket expenditures. Unless wages and other costs could have been further reduced in depression, a substantially lower price level for steel during the past 10 years would have brought general bankruptcy in the industry.

In view of these facts, full production and employment cannot be maintained in the steel industry during depression by means of reduction in steel prices.

These conclusions are based on the assumption of a reduction only in the price of steel. It has often been pointed out that the inelasticity of demand for individual durable goods does not afford an adequate basis for demonstrating the inelasticity of demand for durable goods in the aggregate. This we recognize. What would happen to production and employment if there were greater cyclical flexibility in the prices of all durable goods is a most difficult and perplexing question. Although we have given the matter much study, we have not been able to reach conclusions which we can establish beyond reasonable doubt. We have found that others better qualified to deal with this problem have had the same experience, and that there is on the part of many economists honest doubt as to the efficacy of price flexibility as a cure for depressions. There is, however, general recognition that the existent inflexibilty in costs, particularly in wages, taxes, and transportation charges, all of which are subject in greater or less degree to Government regulation or influence, is so great as to preclude any considerable increase in the flexibility of the prices of

finished products. Unless the costs of producing durable goods are flexible, it is idle to talk of flexibility in their prices.

In analyzing the demand for steel we approached the problem in two ways. First, we undertook to study the demand for steel from major consuming industries. On the basis of rough estimates of the elasticity of demand for the products of these industries and the relative proportion of steel cost to the prices of their products, it was possible to discover approximately the effect of changes in steel prices upon the prices and consumption of the finished products made from steel and thus upon the consumption of steel in these industries. In the second place, we made a statistical analysis of the data over the past 20 years to discover the relation of steel production to steel prices and other factors determining demand, and thereby to ascertain the relative importance of price as a factor influencing the quantity of steel produced and sold.

During the last 15 years the automobile, railroad, and container industries have consumed almost 40 percent of the steel produced in this country. These industries represent three different types of steel consumers, one using steel as a raw material in the manufacture of a consumer's durable good, another using steel in the form of plant and equipment, and the third using steel as a raw material in the manufacture of a consumer's perishable good.

Acting Chairman King. Pardon me, Doctor, but have you broken down that 40 percent to which you have just referred, to determine what percentage of it was required by the railroads?

Dr. Yntema. I haven't the percentage figure handy, Senator, but we have just submitted to the committee a special study, "The Distribution of Steel to Major Consuming Industries." [1]

Acting Chairman King. And that would show the amount which was consumed by the railroads, would it?

Dr. Yntema. Yes, sir; that shows, to the best of our ability to make such an estimate, the amount consumed by the railroads.

Acting Chairman King. Proceed.

Dr. Yntema. The automobile industry: The automobile industry has been the largest single consumer of steel for 5 of the last 6 years, taking between one-fourth and one-sixth of the total of all hot-rolled steel products.

Acting Chairman King. They took between one-fourth and one-sixth of the 40 percent which you have attributed to the automobile and the railroad industries and left the residue, of about 30 percent or more, to the railroads?

Dr. Yntema. There are three industries whose consumption comprises the 40 percent of the total production: The automobile, railroad, and container industries.

Acting Chairman King. Oh, yes.

Dr. Yntema. Although it has had a long-term upward trend, automobile production has been subject to severe cyclical fluctuations. In 1929, approximately 5.6 million cars were produced. In 1932, production slumped to about 1.4 million, only 25 percent of the 1929 production. By 1937, production had risen to approximately 5,000,000 cars, more than three times the volume in 1932.

The reasons for these wide fluctuations in automobile production were carefully analyzed by C. F. Roos and Victor von Szeliski in a

[1] "Exhibit No. 2180," appendix, p. 14095.

study made for General Motors Corporation. They found that the number of new cars sold in any year was dependent on (1) the national income; (2) the number of cars in operation; (3) the age distribution of cars in operation; (4) the scrapping rate; (5) the price; and (6) other factors, including used-car allowance, financing terms, operating cost, and dealers' used-car stocks. Taking all these factors into account, they showed that a 1-percent reduction in the price of new passenger cars would cause approximately a 1.5-percent increase in the number of cars sold. They concluded that the effect of price changes on the number of cars sold was overshadowed by the influence of changes in national income, and that the changes in price could not level out the sharp fluctations in production of automobiles.

The railroad industry: For many years the railroad industry ranked first as a consumer of steel. In 1926, railroads consumed approximately 7.6 million tons of hot-rolled finished products, which represented about 21.6 percent of that year's total production. During the last 10 years, this industry's purchases of steel have declined absolutely and relatively.

The cyclical fluctuations in railroad purchases of steel are particularly marked. In 1932, the railroads took approximately 1,000,000 tons of steel, while in 1937, a relatively good year, they purchased 4.1 million tons, still much less than their predepression consumption.

The serious plight of the railroads is common knowledge. They have suffered both from a downward trend in operation and from the severity of the recent depression. As a consequence, the need for new equipment has declined and the revenues in many cases have been inadequate for maintenance and replacement of existing facilities.

The cyclical fluctuations in railroad traffic have been closely related to changes in the national income and in industrial production, while the downward trend has been due primarily to competition from alternative means of transportation.

Acting Chairman King. You refer to trucks, I suppose, and water transportation?

Dr. Yntema. Yes, trucks and water transportation; also pipe-line transportation.

Capital expenditures for rolling stock and other equipment requiring steel are ultimately dependent upon the demand for rail transportation but in the short run they are determined by the pressure of current traffic on existing facilities and by the funds available for capital outlays. Hence, when the demand for railroad services declines, and only a part of the rolling stock and other equipment is needed to furnish all the services required, there is obviously less need for capital expenditures.

Thus, capital expenditures for equipment dropped from about $328,000,000 in 1930 to about $15,000,000 in 1933, a decline of about 95 percent. Purchases of steel for maintenance purposes have, however, been more closely related to the volume of traffic currently handled by the railroads, since some degree of maintenance must continue even in depression. Nonetheless, declining traffic and lower revenues have drastically reduced total steel purchases by the railroads.

The container industry: Consumption of steel by the container industry (whose principal product is the tin can, a consumers' perishable good) has shown a substantial upward trend since 1923. In

that year the container industry took 3.6 percent of the total finished rolled steel, but since 1932 it has taken on the average more than 8 percent of the total output. In 1938, it ranked third among consuming industries, accounting for 9.9 percent of the total output of steel. While the annual average consumption of steel by the container industry was 1.4 million gross tons during the period from 1923 to 1929, in the period from 1932 to 1938 its annual consumption averaged about 1.9 million gross tons, which is roughly an increase of 36 percent. This relative stability of the container industry during depression periods is further shown by the fact that tin-plate production ranged from about 60 to 90 percent of capacity during the depression, while total steel production varied from about 15 percent to 60 percent of capacity.

Although the demand for products packed in tin cans is largely dependent upon consumers' income, the relatively greater stability of tin-plate production in depression periods is due primarily to the fact that the majority of containers made from tin plate are used for food products. Being a perishable necessity, food must be purchased even in depression times, whereas purchases of more durable products may be postponed. The comparative stability of tin-plate production arises from this fact.

The decline in consumption of steel by the container industry from 1929 to 1932 was further reduced by the underlying upward trend in tin-can consumption, due largely to the increasing use of tin cans to pack additional kinds of foods and other products.

Other investigations have shown that the demand for various agricultural products is inelastic. This is to say that a given percentage price reduction does not produce a corresponding percentage increase in consumption. The available data also indicate that fluctuations in the total consumption of canned food products have had little net relation to fluctuations in canned food prices or to fluctuations in the ratio of canned food prices to other food prices. From these facts, it is reasonable to infer that the demand for canned food products has a low elasticity.

Acting Chairman KING. You have no figures showing the curve of upward or downward steel consumption in building operations, have you?

Dr. YNTEMA. We have that evidence in this pamphlet which we submitted to the committee this morning, "The Distribution of Steel to Major Consuming Industries." [1]

Acting Chairman KING. All right; proceed.

Dr. YNTEMA. Other steel-consuming industries: We have not examined in detail the demand for steel in other major steel-consuming industries. In nearly all cases the products of these industries are durable goods subject to great cyclical fluctuations in demand. Many of them are producers' goods, which are utilized in the production of other goods and services. In such cases, the cost of the product made from steel is not usually a large proportion of the value of the goods and services produced by the industries using these products made from steel. Consequently, there is good reason to believe that the demand for the products of these industries is generally not very elastic and in many cases is inelastic.

[1] "Exhibit No. 2180," appendix, p. 14095.

The relations of the cost of steel to the price of the finished product: The demand for steel is derived from the demand for the services rendered by steel products, or, more directly, from the demand for the finished products themselves. A reduction in the price of steel, if passed on, willl reduce the price of the finished product. In greater or less degree, this will increase the consumption of the product and, thus, the consumption of steel used in its manufacture. Furthermore, a reduction in the price of steel may perhaps increase the use of steel per unit of finished product. In each of these cases, however, the critical question is, how much?

The percentage decrease in the price of a finished product made possible by a reduction in the price of steel depends upon the proportion of the cost of steel to the value of the finished product. What is this proportion?

In the case of low-priced automobiles, the cost of steel is about 10 percent of the delivered price. This percentage would be lower for a more expensive automobile. For a representative list of canned food products, the cost of tin plate per can varied from 3.4 to 13.9 percent of the retail price of such food products. The cost of steel consumed by the railroads is estimated to average only about 5 percent of the value of transportation services furnished by them. In the construction industry, steel costs range from 4 percent of the total cost of a frame house to as much as 30 percent of the total cost of a steel bridge. For a modern automatic packaging machine, the steel cost component was found to be less than 2 percent of the selling price. Extreme examples may be cited showing a very high or very low ratio of the cost of steel to the price of the finished product, but 10 percent appears to be a reasonably typical proportion.

On this basis, a 10-percent reduction in the price of steel would correspond to a 1-percent reduction in the price of the finished product made from steel.

Since the elasticity of demand for the finished products of most steel-consuming industries is low, probably less than 1 or 2, a 1-percent decrease in the price of the product would not increase the quantity sold by more than 1 or 2 percent. If other conditions affecting demand and costs remain the same, a 10-percent reduction in the price of steel would not increase the consumption of steel by more than 1 or 2 percent through its effect upon the price of the finished product.

Substitution of steel for other materials: In the industries studied, price is generally not an important factor in the substitution of steel for other products. The physical characteristics of steel, especially its great tensile strength and durability in comparison with other materials, sharply limit the possible uses of substitutes. In the case of tin cans, there is some degree of substitutability between containers made of tin plate and those made of glass. Even in this case however numerous factors limit the possibility of substitution in response to price changes.

The amount of steel used in the finished product: In the automobile industry, there was for a number of years an increasing use of steel per car due to the growing popularity of closed and heavier models, and the changes in construction in the interests of safety. These developments, however, cannot be attributed to steel prices. In most cases, technical considerations determine, within rather rigid limits, the quantity of steel employed in any particular product.

Although some slight increase in the weight of steel used per unit of product may result from a reduction in the price of steel, this effect is certainly not of substantial proportions.

The elasticity of the demand for steel: From the discussion thus far, it is apparent that the quantity of steel sold is not very responsive to changes in the level of steel prices.

Let me interpolate here, to point out that I am talking about the responsiveness of the total quantity of steel sold by the industry, in response to the changes in steel prices.

To make an estimate of the elasticity of demand for steel in the various consuming industries, we must take into account, first, the elasticity of demand for the products made from steel; second, the proportion of steel cost to the price of the finished product; third, the substitutability of steel for other materials; and, fourth, the possibility of increasing the amount of steel in the finished product. In appraising these factors, we have found that the elasticity of demand for the products made from steel is generally rather low, in most instances, probably not greater than 1 or 2; that the proportion of steel cost to the price of the finished product is, on the average, in the neighborhood of 10 percent.

Acting Chairman KING. Say that again. I didn't get it.

Dr. YNTEMA. And that the proportion of steel cost to the price of the finished product is, on the average, in the neighborhood of 10 percent.

Acting Chairman KING. Going down?

Dr. YNTEMA. That is a very rough approximation.

Acting Chairman KING. But that is going down to 10 percent?

Dr. YNTEMA. It ranges usually from 3 to 30 percent but 10 percent is a roughly typical figure that we might take for discussion.

To continue: The possibilities of substitution of steel for other materials and of increasing the amount of steel in the finished product are of relatively minor importance.

From the evidence, it is safe to conclude that the demand for steel is inelastic, that is, that a given percentage reduction in price will not bring about as large a percentage increase in the quantity sold. Although any such estimate is subject to a wide margin of error it seems probable that the elasticity of demand for steel is not greater than 0.3 or 0.4, that is, that a 10 percent reduction in price would not increase the quantity of steel sold by more than 3 or 4 percent.

In concluding this part of our discussion, it should be pointed out that these estimates are based upon the assumption that other prices and other factors affecting the demand for steel remain the same.

Mr. BALLINGER. Dr. Yntema, how many industries did you analyze that use steel? I mean in testing this elasticity of demand?

Dr. YNTEMA. We analyzed in some detail these three to which I have referred.

Mr. BALLINGER. Representing about 40 percent; the other 60 percent, you didn't look into?

Dr. YNTEMA. Yes; we investigated briefly the construction industry and found the problems there were so complicated that we were not prepared to submit a study of them to this committee.

Statistical analysis of the elasticity of demand for steel: The foregoing conclusions as to the elasticity of demand were tested by a separate statistical analysis of annual series of relevant economic data

from 1919 to 1938. Production, shipments and bookings were respectively correlated with the factors deemed to exert a significant influence on the quantity of steel demanded. These factors were:

(1) The price of steel.
(2) Industrial production.
(3) Consumers' income.
(4) Industrial profits.
(5) A time-trend variable.

From four such correlations involving different combinations of these factors, it was found that a 1 percent decrease in the price of steel (other factors remaining the same) would induce less than a 1 percent increase in steel sales. Subsequent calculations in which mill net yields on shipments of steel, not available at the time of the original study, were used in lieu of published prices, confirmed these results. Although subject to considerable error, the best estimate of the elasticity of demand for steel indicated by this analysis is thought to be approximately 0.3 or 0.4.

These findings confirm our other estimates based on the study of the demand for steel by consuming industries, and indicate that changes in the level of steel prices cause smaller percentage changes in the opposite direction in the quantity of steel sold.

Mr. O'CONNELL. May I ask a question? Why did you use the mill net yield instead of another basis for determining?

Dr. YNTEMA. In relating shipments to price, the appropriate price measure to use is the price obtained on the shipment, and the mill net yields constitute that particular price.

Mr. O'CONNELL. Well, the mill net yield does not represent the cost to the purchaser of steel, does it?

Dr. YNTEMA. No; but the mill net yield fluctuates in the cycle in very close correspondence to the price paid by the customer. If you had a price series of the actual average prices paid by the buyers of steel, and then had a price series of mill net yields, the percentage changes in both series would be almost identical.

Mr O'CONNELL. You mean there would be a closer correlation than there would be to make the comparison with the published prices?

Dr. YNTEMA. No; there are two points that I am making here. One is that if you are studying the relation of shipments to some price, then it must be the price paid for those shipments. The second point that I am making is that because we did not have the actual prices paid by customers, since the data were not available in convenient form, we used a series which paralleled that very closely, namely, the average mill net yield. If you plotted those two series, you would see that the relative fluctuations in them were almost identical. We do not have the two series, but the evidence which will come out in a later discussion, I think, will indicate this beyond any reasonable doubt.

In the period covered by the analysis, changes in the level of steel prices were a comparatively minor influence in determining changes in the volume of steel sales. Even if fluctuations in steel prices had been considerably greater than they were, nevertheless other factors affecting the demand for steel, such as consumers' income, industrial profits, and general business activity, were found to be of such controlling importance that they would still have had far greater weight than changes in steel prices.

Relation of cost to volume of output: Our second problem was to determine how costs varied with output. To accomplish this, a study was made of the relation between cost and volume for the United States Steel Corporation subsidiaries during the period from 1927 to 1938. In computing cost, intercompany items were excluded, as were Federal income taxes and costs connected with extraneous nonoperating transactions. Since the purpose of the analysis was to ascertain the changes in costs which would result from changes in volume of production, the effects of other factors had to be excluded. This necessitated the adjustment of the cost figures for each of the years to the levels of material prices, wages, interest, and tax rates, and pension payments prevailing in 1938, and also an adjustment for increases in efficiency which took place during this period. Having removed the effects of changes resulting from these factors, the adjusted costs could then properly be related to volume of output.

Because of variation in the proportions of low and high cost products, the simple aggregate tonnage of these products was not a satisfactory measure of output for our purpose. To eliminate the effect of these variations in the product mix, proper weights were assigned to low and high cost products and an annual weighted total of products shipped was thus obtained.[1]

When the average relationship of adjusted total cost to weighted volume was obtained, it showed that within a range of operation from 18 percent to 90 percent of ingot capacity, the total costs of the corporation and its subsidiaries under 1938 conditions amounted to $55.73 per weighted ton plus $182,100,000.

It should be noted here that while the costs mentioned are exclusive of all nonoperating income and expense, they cover all operations of the Corporation and, hence, do not represent merely the cost of producing steel. Furthermore, even weighted tonnages shipped do not reflect the full volume of business, since some goods and services are sold by the Corporation which are not measured in tons. Nevertheless other operations rise and fall with increases and decreases in shipments of products to a sufficient extent that the total costs maintain approximately the relationship to shipments just described. Since in 1938, 89 percent of the total revenues came from the sale of steel, presumably about 89 percent of the above costs represent costs directly related to steel production.

Mr. REYNDERS. May I ask a question? In other words, when you arrive at this price, you include such items as fabricated steel, going into buildings and ships?

Dr. YNTEMA. Yes. We have included all the steel products, all the hot rolled products, shipped by the Steel Corporation as such.

Mr. REYNDERS. But only the rolled products?

Dr. YNTEMA. I should like to correct that statement. This includes all the products sold in the form they are sold by the Steel Corporation subsidiaries, whatever form that may be.

Mr. REYNDERS. Then you assign, for instance, to a fabricated steel a higher relative tonnage rate.

Dr. YNTEMA. Yes; that is correct.

Mr. BALLINGER. In that range from 18 percent to 90 percent, is this the cost, $55.73, or would it vary between that range?

[1] To obtain as large a coverage as possible, this weighted total included also products other than steel sold on a tonnage basis by the Corporation subsidiaries, weighted in a similar manner.

Dr. YNTEMA. No, sir; the cost is composed of two parts, as I shall show in a few minutes, a total of $182,100,000 plus an additional cost that varies with output, of $55.73 per weighted ton. I want to make clear that that is not strictly the additional cost per weighted ton of steel. If you could allocate these additional costs on the basis of revenues obtained from steel and other products, i. e., if you multiplied them by 89 percent you would have a rough working estimate of the additional cost of steel per ton.

This $182,100,000 represents the portion of the costs under 1938 conditions which remained the same, independent of variations in production within the above-stated capacities—provided, of course, that other factors affecting costs stayed constant. This "fixed cost" included not only interest and pensions, but also the portions of all other costs which did not vary with output. The $55.73 per weighted ton represents the additional cost of all operations per additional ton of product. This additional cost per ton remains constant throughout the range of operations covered by the data. The average cost per ton, of course, decreases as volume rises.

The elements composing these additional and fixed costs follow in table 1:

TABLE 1.—*Elements of total costs, 1938 conditions, United States Steel Corporation and subsidiaries*

Item	Cost that does not vary with production	Additional cost for each additional weighted ton of product shipped
Interest	$8,300,000	0
Pensions	7,700,000	0
Taxes other than Social Security and Federal income	24,200,000	$1.43
Pay roll	62,100,000	29.10
Social Security taxes	2,500,000	1.16
Other cash expenses	47,800,000	21.67
Total cash costs	152,600,000	53.36
Depreciation and depletion	29,500,000	2.37
Total costs	182,100,000	55.73

Acting Chairman KING. It may be included in your testimony.

Dr. YNTEMA. I should like to point out one or two characteristics of this table. In the first place, that of the $55.73 additional cost per weighted ton of products shipped. The additional pay roll accounts for $29 and the additional other cash expenses, made up largely of materials and services purchased from others, account for $21. The depreciation and depletion is a relatively small item of the total.

Of the total costs, $53.36 of the additional costs and $152,600,000 of the fixed costs are cash outlays, and the respective remainders consist of depreciation and depletion.

I might interpolate there with one comment, that even in the case of depreciation and depletion you can't avoid entirely some of the expenditures necessary for replacements and additions to equipment during depression. Those are costs which in the long run also must be met in cash.

Mr. HINRICHS. May I ask one question in this connection? In these costs that do not vary with production you show a total of $62,100,000 for labor.

Dr. YNTEMA. Yes, sir.

Mr. HINRICHS. And you then show variable pay-roll costs of $29.10 a ton.

Dr. YNTEMA. Yes.

Mr. HINRICHS. For additional labor per ton for whatever volume of production there may be. That indicates an absolutely linear relationship as far as labor costs are concerned, yet fixity in the bottom end, perfect variability within the range of 18 to 90 percent of capacity production. Have you tested out other types of relationship as well as the straight linear relationship? Are you convinced on the basis of numerous other tests that that relationship is absolutely linear, because that is a different concept than I think the steel industry itself has had in the past.

Dr. YNTEMA. In "Exhibit No. 1416," p. 28,[1] there is a chart which indicates the relation of pay rolls to millions of weighted tons of all tonnage products shipped. The dots cluster very close to a straight line.

Mr. HINRICHS. I am sorry, my memory for numbers isn't good.

Dr. YNTEMA. It is "Exhibit No. 1416," entitled "An Analysis of Steel Prices Volume and Costs."

Mr. HINRICHS. Summary?

Dr. YNTEMA. No, the larger pamphlet.

Mr. HINRICHS. Page 28, you say? [1]

Dr. YNTEMA. Yes, sir.

Dr. KREPS. We shall have something to say about that linear relationship when Dr. Louis Bean takes the stand.

Mr. HINRICHS. My question was essentially whether you had tried other types of relationship as well and concluded that this was the most significant.

Dr. YNTEMA. No, we haven't tried other types of relationship.

Mr. HINRICHS. This is based on the inspection——

Dr. YNTEMA (interposing). It is based on inspection. I should be reasonably certain, however, that with inspection you wouldn't obtain a better fit from some other function. That is supported by other studies we have made. We have analyzed the relationship of man-hours to output by months and also by subdivisions of the Corporation, and in most cases we get very nearly a straight-line relationship, although in some instances, surprisingly enough, the tendency is for the line not to rise throughout at a constant rate but, at the higher rates of operation, to fail to rise at the same rate as it does in the lower range of the curve. I should say, however, that you get a very good description of the behavior of labor costs in relation to output—when you have adjusted for differences of the average hourly earnings at different points—by fitting a straight line to the data.

Acting Chairman KING. Proceed.

EFFECTS OF PRICE REDUCTIONS

Dr. YNTEMA. From the relationship between costs and volume it is possible to determine the increase in volume necessary to compen-

[1] Appendix, p. 14053.

sate for a given price reduction. Although our estimates of the elasticity of demand for steel are less than 1, it will be assumed in the following calculations that a given percentage reduction in price will cause an equal relative increase in the volume of steel sold, so that the dollar amount of sales will remain the same. In other words, the elasticity of demand will be assumed equal to 1.

The sales and revenues of United States Steel Corporation subsidiaries in 1938 amounted to $77.66 per weighted ton of products shipped. Of this amount $71.86 represented the amount received from the sale of steel and other products, and $5.80 represented income from transportation and miscellaneous operations.

On the assumption of unitary elasticity of demand and no increase in transportation and miscellaneous operating revenues, a 10 percent decrease from the average price level in 1938 would require an increase of 48.8 percent in volume of shipments to avoid loss from price reduction. But the maximum increase in volume to be expected from the price reduction, on the assumption made, is only 11 percent. Thus it is clear that a price decrease would induce only a small proportion of the tonnage increase which would be necessary to compensate for it.

In table 2 this relationship is shown for price reductions ranging from 1 to 20 percent.

I should like to insert table 2 in the record and defer discussion until a later time when I shall show a chart which perhaps will bring out more clearly the significance of this material.

TABLE 2.—*Percentage increases in volume needed to offset various percentage reductions from average 1938 prices and effect of price reductions on losses—United States Steel Corporation and subsidiaries*

Percentage reduction in price	Percentage increase in volume needed to compensate for price reduction	Percentage increase, assuming elasticity of 1	Estimated additional loss, assuming elasticity of 1	Estimated additional loss, if no increase in volume resulted from price reduction
1	3.39	1.0	$3,900,000	$5,600,000
2	7.01	2.0	7,900,000	11,200,000
3	10.91	3.1	12,000,000	16,800,000
4	15.09	4.2	16,200,000	22,400,000
5	19.60	5.3	20,500,000	28,000,000
6	24.48	6.4	24,900,000	33,600,000
7	29.77	7.5	29,300,000	39,200,000
8	35.54	8.7	33,900,000	44,800,000
9	41.83	9.9	38,500,000	50,400,000
10	48.75	11.1	43,300,000	56,100,000
11	56.38	12.4	48,100,000	61,700,000
12	64.82	13.6	53,100,000	67,300,000
13	74.24	14.9	58,200,000	72,900,000
14	84.78	16.3	63,400,000	78,500,000
15	96.70	17.7	68,700,000	84,100,000
20	190.26	25.0	97,400,000	112,100,000

In 1938 the subsidiaries of the United States Steel Corporation shipped 7,800,000 weighted tons, while in 1937 they shipped 13,200,000 tons. To bring the 1938 weighted tonnage up to the 1937 level, a 69.23 percent increase would have been necessary. On the assumption of a unitary elasticity of demand, this would have required a price decrease of 40.9 percent. After such a price reduction, revenue per weighted ton would have been $48.26, or $5.10 less than the additional cost per ton of products shipped. On the assumption (contrary to our previous findings) that the price reduction of 40.9

percent would have been sufficient to restore the 1937 volume, 13,200,000 weighted tons would have been sold. The Corporation and its subsidiaries would then have had a cash loss of $152,600,000 out-of-pocket fixed costs plus a further loss of $5.10 per ton, or a total cash loss of $219,920,000. If depreciation and depletion of assets at this rate of operations, amounting to $60,784,000, were added to the cash loss, the total loss would have been $280,704,000. In 1 year this would have wiped out more than half the current assets of the Corporation.

The 1938 price level used in the foregoing calculations is the average price in effect both before and after the June 1938 reduction of approximately 10 percent in the published prices. The relationship between annual sales and revenues and annual costs at various levels of production has also been computed on the basis of prices prevailing during the second half of 1938. At this lower price level the break-even point (under 1938 cost conditions, without any allowance for dividends on preferred stock) would have been at about 10,500,000 weighted tons, which is equivalent to an operating rate of 50 to 55 percent of capacity. A 10-percent reduction in prices from this level would have raised the break-even point to about 90 percent of capacity. If the break-even point were this high, the Corporation would have to operate at the impossible annual rate of 130 percent of capacity to earn a return before income taxes of only 5 percent on its investment in tangible assets.

At this point, if it please the committee, I should like to show this material in chart form. I think it may be somewhat clearer.

Acting Chairman King. Proceed.

Dr. Yntema. This is chart B-9 in "Exhibit No. 1409."[1] It is entitled "Unadjusted Costs and Volume of Business Compared With Estimated Costs for Corresponding Volumes Under 1938 Conditions." For the time being I should like to neglect this dotted line we have drawn through the chart; I will come back and show the significance of that later on.

We have plotted here the millions of dollars of costs, the actual unadjusted costs, neglecting, however, intercompany items and non-operating transactions which are extraneous to the production process of the Corporation. We have plotted here the millions of weighted tons of all tonnage products shipped; that is, weighting the lower-cost products and the higher-cost products in such a way as to obtain as satisfactory an index of volume of production as possible.

These dots represent the costs and the volume of production in the respective years. For example, in 1929 the cost of production was represented by the height at this point above the base line, and the distance from the left-hand side of the chart over to the point represents the tons of products shipped.

These are the data with which we began our cost analysis. They are the actual unadjusted costs and the weighted tonnages of products shipped. You can see that even without any adjustment they are distributed roughly along a straight line.

I should like to show now, by another chart, the effect of our adjustments upon these points.

Dr. Kreps. What number is this next chart?

[1] Appendix, p. 13789.

Dr. Yntema. This is No. B–1 in "Exhibit No. 1409,"[1] entitled "Relationship Between Total Costs of Operation and Volume of Business—1938 Conditions." Along the horizontal base line we are still plotting the millions of weighted tons of all tonnage products shipped. There has been no adjustment in that for each of the years, but we have in each year adjusted these total costs as I have described in the statement just submitted to the committee. In each case we have taken the components of cost, the pay rolls, the taxes, and other costs, and adjusted them to the wage rate, tax, and material price conditions existing in 1938 insofar as those adjustments were possible. We don't claim perfection for such adjustments. There are many obstacles in the way of achieving perfection, but we think these represent reasonably satisfactory adjustments. I understand there will be some discussion of this question later before the committee. There may be more elaboration of these adjustments at that time.

Even a casual inspection of the chart will show that these points lie very closely upon a straight line, and we have therefore fitted such a line to these observations. This line purports to show, then, how the total costs of the Steel Corporation would vary with variation in volume, removing, however, the effects of changes in wage rates, material prices, tax rates; it shows how total costs would respond to changes in one factor alone, changes in volume.

We don't particularly want to call attention to the extrapolation of this line beyond the range of the data. We are not interested in that. Extrapolating the line does give, however, a convenient method of describing how the costs behave. This amount of $182,100,000 we have determined as fixed cost. It represents in a sense the amount of cost which does not vary with output. The total costs rise by a constant amount per ton as the volume increases. That increase in total costs, per ton increase in volume, is the additional cost, $55.73, which I have described in the statement just read to you.

This next chart is No. B–2 in "Exhibit No. 1409."[2] It is entitled "Composition of Total Costs of Operation in Relation to Volume of Business." It shows total costs in relation to output, exactly the same line that was just presented to you in chart B–1. We have taken the line of total costs from chart B–1 and placed it here. Then we made an analysis of the behavior of the individual components of cost; we took the components of the total cost and studied how they were related to volume. This chart gives the result of those studies. They are described in somewhat greater detail in "Exhibit No. 1416" entitled "Analysis of Steel Prices, Volume and Costs."

CASH COSTS

Dr. Yntema. There are two characteristics of this chart which I think are interesting. One of them is the relatively small proportion of noncash outlays. The goods and services purchased from others must be paid for in cash from year to year. Social Security taxes must be paid for in cash from year to year. The pay roll must be paid for in cash from year to year. The depreciation and depletion to some extent, to a very considerable extent, may be deferred, but

[1] Appendix, p. 13773.
[2] Appendix, p. 13775.

even that cannot be completely deferred in depression; what I mean is that there is even in depression necessity for making some expenditure for replacement of equipment. The taxes other than Federal income and Social Security taxes must be met in cash from year to year. You notice, therefore, that of the total costs, the total variable costs, so-called, practically all of them are cash outlays; only a very small proportion represents noncash outlays. Of the so-called costs which we have termed "fixed costs" the goods and services purchased from others must be paid for in cash; the Social Security taxes must be paid in cash; the pay roll of course must be met by cash expenditure; the depreciation and depletion does not represent entirely immediate cash outlays. The taxes other than Federal income and Social Security taxes must be met in cash, and pensions, and interest of course represent cash payments.

In summary, therefore, the proportion of noncash overhead is indeed very small. You will notice, furthermore, that we have not included in this chart any provision for dividends or profits.

Mr. WOODEN. Does the item of goods and services purchased from others include only raw materials used in the manufacture and production of steel?

Dr. YNTEMA. It includes raw materials purchased from others.

Mr. WOODEN. For use only in the manufacture of steel?

Dr. YNTEMA. For use by the Steel Corporation in all its operations. We have tried to bring together all operations in this picture. The reason for doing that is not that we did not want to analyze the components, but that any analysis of the component operations would involve questions of accounting allocation which of necessity would be arbitrary.

Mr. WOODEN. Do you have any break-down between the cost of goods the cost of services purchased from others?

Dr. YNTEMA. It wasn't possible for us to obtain that break-down without a tremendous amount of work. If it had been available we would have used it, but we found it was impossible to get that information because of the particular way in which the records of the Corporation were kept, each subsidiary corporation's records being kept as a separate entity.

Mr. HINRICHS. When you speak of pay roll you are referring to all payments for services, including your salaried workers, payments to officials as well as wage earners?

Dr. YNTEMA. Yes, sir; but not for all services, it doesn't include some types of professional service obtained from others, but it includes all the salaried pay roll to the corporation employees.

Mr. REYNDERS. They are in that lower range of salaried pay roll shown on this chart, aren't they?

Dr. YNTEMA. I can't tell you what the distribution is. A good deal of the salaried employees I think wou'd appear in this pay roll included among "fixed costs" at the bottom of the chart, but even there it may not be entirely true. I just can't tell you the extent to which this item is composed of wage earners and the extent to which it is composed of salaried workers.

Mr. REYNDERS. The straight-line characteristic of your labor is a fortuitous circumstance, isn't it, because the higher operating rate you have, the higher are the rates of labor.

Dr. YNTEMA. No; we have eliminated the effects of differences of average hourly earnings for all employees. We found by study that the average hourly earnings of all employees, wage earners and others, are approximately the same, independent of output, so long as there are not wage rate changes. We have a chart here which we will be glad to put in evidence if you would like to see it, showing that particular point. I think later on in the discussion we should like to present it to the committee.

In this next chart, No. B–3, in "Exhibit No. 1409,"[1] entitled "Relationship Between Sales and Costs—Effect of Reduction from Average 1938 Prices," again we have taken this line representing total costs determined in the earlier chart, No. B–1, and we have superimposed upon this chart two other lines, one—the light double line—representing total sales and revenues at 1938 average prices. This light double line represents what average sales and revenues at the various volumes would be under 1938 prices. In other words, the height of this line at any given point of volume represents what the total sales and revenues would have been at 1938 prices if this volume had been sold.

The point at which the total sales and revenues are equal to the total costs, sometimes called the break-even point, appears in this chart at approximately 8,300,000 weighted tons of all tonnage products shipped, on the basis of average 1938 prices. If the price had been reduced, if the 1938 average prices had been 10 percent lower, the sales and revenues line would have been represented by this heavy broken line on this chart. You see that for any given volume of product the height of this line is 10 percent less than that of the light double line above it on this chart.

The break-even point in that latter case would have come at approximately 12,500,000 tons of all tonnage products shipped, or roughly the break-even point would have been in the neighborhood of 70 percent of capacity. This shows the effect of a 10-percent reduction from the 1938 average price level upon the break-even point.

Mr. HINRICHS. You just said 70 percent; in your earlier testimony, if I remember correctly, you said a 10-percent reduction in prices would have raised the break-even point to about 90 percent of capacity.

Dr. YNTEMA. No; that applies to the level of prices prevailing in the second half of 1938, and I will show in just a moment a chart corresponding to that testimony.

Mr. WOODEN. Is it a composite base price or a composite mill-net yield that you have used there?

Dr. YNTEMA. That is the composite of actual receipts.

Mr. WOODEN. Mill-net yield?

Dr. YNTEMA. This is mill-net yields for all steel products and net yields to the Corporation from all other nonsteel products as well.

This next chart is No. B–4 in "Exhibit No. 1409."[2] It is entitled "Increases in Volume Needed to Compensate for Various Decreases in 1938 Prices Compared to Probable Resulting Increases in Volume."

You will remember in the statements which I made a few minutes ago that we assumed in our calculations an elasticity of 1 for demand for steel, although we thought the elasticity was considerably lower than that. We have plotted along the base line the percentage de-

[1] Appendix, p. 13777.
[2] Appendix, p. 13779.

creases from the average 1938 prices, and this black line labeled "Probable Resulting Increases in Volume" shows what the volume increase would have been if the elasticity of demand were unity.

The height of the bars in the chart shows what the increase in volume would have had to be if the price decrease had not brought a financial loss to the corporation. You can see very readily that in all cases the needed increase in volume required to offset the decrease in price was far greater than any increase in volume which could reasonably be expected to eventuate from the price reduction.

This next chart is numbered B-5 in "Exhibit No. 1409." It is entitled "Estimated Additions to 1938 Deficit. How Deficit Would Have Increased if Prices Had Been Reduced and Volume Had Increased to Same Relative Extent." In this chart we have plotted along the base line various percentage reductions in the 1938 average price. The black part of the bar in each case represents what the 1938 deficit of the Steel Corporation actually was. The dotted part of the bar above the black portion represents the addition to the deficit if prices had been reduced as indicated by these respective percentages on the base line. Thus, for example, if there had been a 10 percent reduction in price the additional deficit would have been indicated by the large dotted portion of the bar above the lower black portion over the figure 10 on the base line.

Dr. Kreps. Would you carefully state for the committee what the assumption is upon which you base these estimates?

Dr. Yntema. Yes. We have assumed, first, an elasticity of demand of one for steel.

Dr. Kreps. By demand you mean market demand rather than demand in what is called the schedule sense?

Dr. Yntema. We use elasticity in this sense, that if the price were reduced 1 percent there would be a 1 percent increase in quantity of steel which would be bought.

Dr. Kreps. You mean you are, therefore, allowing for no effect in the reduction of the price of steel upon general business activity, consumer income, and industrial profits.

Dr. Yntema. Yes. We are neglecting for the time any such indirect effects; it seems to me beyond possible doubt that the indirect effects increasing the possible elasticity would be far less than the error we have made by assuming as high an elasticity as one. I state that merely as my own personal opinion, that we have erred on the upper side. Even if we took the definition which you have suggested as an alternative I think the elasticity still would not be greater than one.

Dr. Kreps. This does not depend so much upon the elasticity of demand as upon the nature of your cost curve, does it not?

Dr. Yntema. I should say that it depended upon both, that if you made large changes in either one you would get somewhat different results, but if you made moderate changes in the cost function or moderate changes in the elasticity of demand for steel, either one, you would still get substantially the same order of results.

Dr. Kreps. You agree that general business activity, consumer income, and industrial profits affect the volume of steel sold, do you not?

Dr. Yntema. Oh, that is correct, they are much more important than price.

Dr. KREPS. You do not mean to say that the volume of steel sold, the amount of employment in the steel industry, steel being roughly $1 out of 14, in the economy, has no effect upon industrial activity, upon consumer income, and upon industrial profits?

Dr. YNTEMA. No; I would never want to be quoted to that effect—that the amount of steel sold has no effect.

Dr. KREPS. Yet in your charts you have made no such allowance, have you?

Dr. YNTEMA. Let me make clear what we have in the charts. We have assumed with reference to the elasticity of demand a figure which we think is high, perhaps twice or three times as high as we believe to be the best estimate. We have tried to be conservative in that respect. We would recognize that if you allow for the secondary repercussions there would be perhaps some increase in that elasticity. I personally regard those effects as much smaller than the margin of error which we have introduced by assuming an elasticity of 1 instead of 0.3 or 0.4.

Dr. KREPS. That is your own personal estimate. You have made no calculations?

Dr. YNTEMA. No; I don't see how it would be possible to make satisfactory calculations on that point.

Dr. KREPS. You have made no endeavor to show to what extent the activity in the steel industry and the leadership furnished by steel executives and by steel price policies tends to influence if not affect and determine general industrial activity and the general level of industrial prices?

Dr. YNTEMA. We are carrying on research, not in the Steel Corporation but in the Cowles Commission at the University of Chicago, on the demand for steel, and if you or anyone else has any other suggestions as to how to proceed in such an investigation we shall be more than delighted to receive them.

Dr. KREPS. We have some suggestions in that regard.

I want merely to make clear for the record that the assumption upon which these charts are based is contrary to economic fact.

Mr. BALLINGER. Dr. Yntema, I have been very much impressed with your logic, but I have one question I want to ask. Why does the Steel Corporation ever reduce prices then, since it seems to be a ruinous policy? I mean they are going to sell the same amount of steel for less revenue. That doesn't seem to make sense.

Dr. YNTEMA. I don't like to get into a long discussion. I think the answer is competition.

Mr. BALLINGER. If there were none?

Dr. YNTEMA. If there were no competition in the steel industry the prices would certainly be much higher than they are and have been In short, I think it is due to competition in the steel industry.

Mr. BALLINGER. Assuming there was no competition, is there any way you can explain it except there is elasticity to the demand for steel? Suppose we settle that, then how could you explain a reduction in the price of steel except on the condition that the demand for steel was elastic?

Dr. YNTEMA. If there were no competition—that is a condition which I think is contrary to fact—in the steel industry——

Mr. BALLINGER (interposing). Price competition.

Dr. YNTEMA. No price competition in the steel industry, no effective price competition in the steel industry? I think you could explain these facts only by the goodheartedness of the steel industry.

Acting Chairman KING. Is it not a fact that in many industries during this depression and even at other times there have been losses, deficits, which have been made too often by invading capital and impairing utimately the economic structure or stability of the corporation

Dr. YNTEMA. I didn't get one part of the question—by doing what to capital?

Acting Chairman KING. Invading capital.

Dr. YNTEMA. By invading capital?

Acting Chairman KING. That is making it less valuable.

Dr. YNTEMA. Of course, it is true that if an industry does not maintain its productive facilities at a level with current technological advances, consumers suffer thereby. I think it is possible to name industries of that sort. I am no expert in the railroad industry, but I think the railroads have suffered so severe a depression that that probably has been true. I can't offer that as expert opinion, but only as a lay observer.

Acting Chairman KING. From your studies of our economic and industrial situation have you discovered that many industries continue to function as best they may, even though they are sustaining annually very severe losses?

Dr. YNTEMA. I think that there are many industries which, in spite of the losses they sustain, still maintain a fairly high level of technical efficiency. I think there is no doubt but that in depression technical advances may sometimes be slowed up due to the fact you cite. It is hard to generalize in as complicated a question as that. I doubt if that has been a major factor retarding technical progress. I don't think it has in the steel industry.

Acting Chairman KING. I didn't refer particularly so much to technical progress, but merely to disposition of men in business whether small business or large business, whether in the agricultural business, the production of agricultural commodities, sugar for instance, or in the mining industry in the production of copper, lead, zinc, and other ores, is it not a fact that in many of those cases there have been losses for protracted periods and yet the mines couldn't afford to close down, the agriculturists couldn't afford not to plow their fields, they had to raise something, and they have met their losses with a good deal of courage and sometimes they haven't met them and have gone into bankruptcy, but have continued oftentimes for indefinite periods, hoping that the clouds would be dissipated and the sun would again shine.

Dr. YNTEMA. I think that there are many stockholders in the steel industry and many managers in the steel industry who would have a sympathetic response to that suggestion.

Dr. KREPS. And laborers you would add, wouldn't you?

Dr. YNTEMA. Yes; quite so.

Acting Chairman KING. When corporations shut down or close their business or farmers don't produce, when mines shut down, the laborers suffer of course, so obviously it doesn't need any explanation.

Mr. FELLER. Assuming that the rate of operation of the Corporation is in the neighborhood of 80 percent today, does it follow from your

charts that if the Corporation were to double its price today and be content with a rate of operation of 40 percent they would make just as much money?

If you take half the production at twice the price and make just the same profit?

Dr. YNTEMA. I think you would make a larger profit. If you obtained the same total income and reduced your costs you would make a larger profit than you did before.

Mr. FELLER. Your costs would be reduced?

Dr. YNTENA. Yes; if you reduced your operations from 80 to 40 percent.

Mr. FELLER. On your calculation, you mean the average cost per ton of steel would go down?

Dr. YNTEMA. No; the average cost per ton of steel would go up.

Mr. FELLER. If you reduced your operation to 40 percent?

Dr. YNTEMA. Yes; but the margin would be so much greater that the total profit would greatly exceed the current profit.

· Mr. FELLER. Then isn't the industry very foolish in attempting to get all this business? Why don't they go after less business?

Dr. YNTEMA. It is true that if any business were perfectly free to set its prices anywhere it pleased, most businesses would set their prices higher and most businesses would make larger profits, but that is not the way business has to operate. Most business today is competitive, and the limits upon the prices which any particular business can set are determined by competition. It is not possible for the Steel Corporation or for any concern in the steel industry to set its prices at any level that it pleases. These phenomena would reveal that fact if they were approached with some understanding of the degree of competition which does exist in the steel industry.

Mr. FELLER. Let's assume a constant price, then. Assuming that the price is not raised, the price remains at the present level. On the cost curve that you showed us a while back wouldn't it follow that the increment to profit which results from increases in the rate of operations would progressively get smaller and smaller?

Dr. YNTEMA. Perhaps I can deal with that question in terms of this chart. This is chart B-3 in "Exhibit No. 1409" [1], entitled "Relationship Between Sales and Costs. Effects of Reduction from Average 1938 Prices." The solid black line in this chart represents the total cost under 1938 price, wage rate, tax rate, and other conditions at various volumes of production. The double line represents what sales and revenues would have been at various rates of operations with 1938 prices. Now the second question which you put to me might be answered in this way. If you took, for example, the rate of operation at 14,000,000 of weighted tons of all products shipped, the difference between this double line and the solid black line would represent the profit under 1938 conditions, with the exclusion of such items as we have recognized. If we drop down to 7,000,000 tons, the income would then have been less than the cost, so a reduction in rate of operations from 14,000,000 weighted tons to 7,000,000 weighted tons would have converted a profit into a loss. That is based upon the assumption that there is no change in prices.

[1] Appendix, p. 13777.

Dr. KREPS. And on the additional assumption that the costs which you show for the United States Steel Corporation are costs that apply to every other corporation in the industry.

Dr. YNTEMA. Yes; that is quite right. My remarks here don't apply to the other corporations in the industry. I am talking now about the relation between price levels and costs for the Steel Corporation.

(Mr. O'Connell assumed the Chair.)

Mr. FELLER. The reason you have those two lines is this, isn't it: That there are $200,000,000 approximately of fixed costs, $200,000,000 of costs which never vary, which are invariable. Your variable costs, however, you have shown go up in a straight line. Your sales line——

Dr. YNTEMA (interposing). Pardon me, the variable costs per unit remain constant. The aggregate of all variable costs goes up in a straight line.

Mr. FELLER. The variable costs per unit remain constant. Therefore, the only possibility of making an increased profit on increased rate of operations, the price remaining the same, is in that $200,000,000, fixed cost. That is right, isn't it?

Dr. YNTEMA. There are many ways of saying this. One way of putting it is as follows: If the price is above the initial cost the larger the number of units you sell at that price the larger the profit. That is apparent, because if you increase your volume the income increases more rapidly than the costs for producing and supplying the product. If the price were to be brought below the variable costs, the losses would go up as the volume increased. If the price were exactly equal to the variable cost, the total loss would be equal to the overhead, no matter what the volume.

I should like to make one comment parenthetically, if I may. Any statistician of any competence would know that you cannot, by fitting a straight line to a series of points, show that that is precisely the true functional relation between one variable and the other. But you can say, if the points approach very closely to a straight line, that it represents to a reasonable degree of approximation, the functional relation in question. I don't want to be quoted as saying that the additional costs are precisely $55.73, and that they stay precisely constant. I would say that the evidence we have surveyed indicates that that is a reasonable approximation to the facts.

Dr. KREPS. To the facts for the U. S. Steel Corporation?

Dr. YNTEMA. To the facts for the U. S. Steel Corporation.

Dr. KREPS. Which you are applying to the entire industry?

Dr. YNTEMA. No. Now, let's make clear two types of things. What I am suggesting is this: Not that for the entire industry the cost function would be identical with this, but that the operations of producing steel are somewhat similar in the other steel corporations.

Dr. KREPS. But the results are dissimilar as shown by the proved records of the various corporations, are they not?

Dr. YNTEMA. If I may continue, the operations are similar, and if you were to construct a cost function for the other corporations in the industry, you would find, as a matter of fact, somewhat the same type of pattern. Where the profit margins are larger, you would find, of course, that the cost line would be lower in relation to the

income line; where the profit margins are narrower, you would find that the cost line was higher in relation to the price and income line.

Dr. Kreps. Do you have——

Dr. Yntema (interposing). Just a minute. If the committee would like to see a chart which was prepared, which hasn't yet come from the drafting office, we will be glad to submit this afternoon an exhibit which shows the unadjusted cost figures for a number of concerns in the steel industry. Now, those costs have not been adjusted. They are not comparable strictly to what we have had presented to the committee, but I think they will throw some light on this problem and we will be glad to offer them. They are not our own figures.

Dr. Kreps. I want to pursue one point just a little further. This cost line is the cost line for the United States Steel Corporation is it not?

Dr. Yntema. That is correct; under 1938 conditions.

Dr. Kreps. Quite. You make no assumptions what it would be for other competitors, let's say, in the steel industry?

Dr. Yntema. No, we make no assumptions because we have said nothing about that except implicitly to this extent: I have made no detailed study other than what appears in this chart. We haven't access to the figures of our competitors. I wish we did. It would be a very interesting study to make, to compare the cost functions of other companies in the industry. [Laughter.]

My judgment is this, that because the operations are somewhat similar and because the companies have to compete in the same markets generally for the services and products which are employed, the cost functions would be somewhat similar. Now, there would be a difference due to the degree of integration. The lower the degree of integration in the companies, the smaller would be the fixed or overhead cost and the higher would be the variable cost. So that I should suspect, if anything, that the other—that many of the other smaller companies in the industry would have a comparatively smaller proportion of overhead costs. But I am merely inferring that and I can't say it with any certainty.

Mr. Feller. Dr. Yntema, I just want to get the exact significance of your testimony with relation to costs. Did I understand this to be correct, that looking at the chart, which I think is B–2, the largest segment in the sloping part, the variable cost part, is taken up by pay-roll?

Dr. Yntema. That is correct.

Mr. Feller. Now, your testimony is to this effect, that at all rates of operation, once the Corporation has passed this $200,000,000 fixed cost, at all rates of operation, the unit cost of labor per ton of steel is constant; is that correct?

Dr Yntema. Well, the additional cost, of additional labor per ton of all products is approximately constant, and that is borne out by other studies we have made. I think that is a very reasonable approximation of fact.

Mr. Feller. I just wanted to get that clear.

Dr. Yntema. It is conceivable that some conditions might exist under which that might not be true, but that, I think, is the fair approximation to a description of the facts.

This next chart is numbered B–6 in "Exhibit No. 1409,"[1] and is entitled "Relationship Between Sales and Costs. Effect of Reduction from 2nd Half 1938 Prices." It is similar to chart B–3 in "Exhibit No. 1409"[2] except for the fact that the sales and revenue line is based upon the price levels prevailing in the second half of 1938 instead of the full year of 1938.

In the middle of 1938 there occurred a substantial reduction in steel prices, and this gives effect to that reduction in the price of steel. As a consequence of that reduction the break-even point before any provision for return on preferred or common stocks, rose to approximately 50 or 55 percent. If the price were further reduced 10 percent from the level prevailing in the second half of 1938, and if the other conditions in the year 1938 had prevailed, the break-even point would have risen to 90 percent; in other words, under the wage rates, tax rates and price levels prevailing in 1938, a price level 10 percent lower than the price level prevailing in the second half of that year would have necessitated an operating rate for the Steel Corporation of 90 percent, merely to cover its costs without any allowance for return to the stockholders. If there had been included a provision of 5 percent of return on the total investment in the Steel Corporation, that is, the total assets less the current liabilities, the break-even point would have had to be 130 percent.

That provides some evidence as to the possibilities further of reductions in prices from the level prevailing in the second half of that year.

Since that time, there have not been major changes in the published prices of steel products.

Mr. WOODEN. I take it that means, however, that it would not be necessary to have a 130 percent rate of operation necessarily for other units or other members of the industry?

Dr. YNTEMA. No, it would not. For some it probably would be necessary to have higher rates than that and for others lower rates.

Mr. WOODEN. Have you gone into that question?

Dr. YNTEMA. No, we have not. As I said, in order to make a complete study, I think this should be done for all the operating units in the steel industry, but that, of course, is not within our province. We made a preliminary study and I think in all likelihood when you completed such a study, you wouldn't find greatly different results from those we have shown here, but that again is a matter of opinion based upon the examination only of limited published evidence.

This next chart is numbered B–7 in "Exhibit No. 1409."[3] It shows the increases in volume needed to compensate for various decreases in second-half 1938 prices, compared with the probable resulting increases in volume. There is no need to describe the chart in detail. It is similar to the chart preceding.

What it shows is that if there were to be decreases from the price level prevailing in the second half of 1938, the increases in volume necessary to compensate for the price decrease and leave no further loss, would have been still greater than in the chart which you have just seen.

[1] Appendix, p. 13783.
[2] Appendix, p. 13777.
[3] Appendix, p. 13785.

This next chart is numbered B-9 in "Exhibit No. 1409" [1] and is entitled "Unadjusted Costs and Volume of Business Compared with Estimated Costs for Corresponding Volumes under 1938 Conditions." We have inserted in this chart a line showing the relation between adjusted cost, that is, adjusted to 1938 conditions, and volume of production. We have also inserted in this chart the actual costs, not the adjusted costs, but the actual costs in these respective years.

Some interesting observations might be made from this chart. One is that the level of cost prevailing in 1938 at various volumes of output is this line, which represents what the cost would have been under the 1938 wage rate, tax rate and price conditions at various volumes of output for the United States Steel Corporation. The cost level of output under 1938 conditions was substantially higher than it had been in the years preceding; that is, the net effect of the price changes and increases in wage rates, has been to increase substantially the cost of production of steel, at least insofar as the evidence to be obtained from the operations of the Steel Corporation is concerned.

Now, it is possible, as I will show in the chart to follow, to compute an index by taking the ratio of the actual costs in 1929 to what the costs would have been under 1938 conditions for that volume, the ratio of the costs in 1930 to what the costs would have been under 1938 conditions for that volume, and thus to get an index of what the actual costs were to what they would have been under 1938 conditions. Let me present that in the following chart.

This chart is numbered C-25 in "Exhibit No. 1409." [2] It is entitled, "Composite Mill Net Yield and Cost per Weighted Ton Shipped. United States Steel Corporation and Subsidiaries." The lines represent index numbers. The dotted line depicts an index of the average actual cost per weighted ton of products shipped. The actual cost per ton—average actual cost per ton—reflects the effect of changes in wage rates, changes in material prices and prices of services, changes in tax rates and also changes in the volume of production. The average costs tend to go up—do go up—as the volume of production declines, because the fixed costs are then spread over a smaller number of units of output.

Dr. KREPS. Dr. Yntema, would you explain the relationship between these curves and profits? You do not mean to imply by the fact that your index of composite mill net yield is below the index of costs, from 1929 on, that there has been no year in which the Corporation has made a profit, do you?

Dr. YNTEMA. No; Dr. Kreps. I was coming to that point in just a moment. I should like to take these curves and explain what each of them is and then come to your question. That is a point which should be made clear in the discussion of this chart.

This second double line represents, on the basis of the chart we have just shown, an estimate of what the costs would have been in these various years under the wage rate conditions, the tax conditions, and the material price conditions in those various years, but with the volume of production which had existed in 1926.

Now, this is to some extent arbitrary, but I think it is none the less a rather useful separation of the effects of two factors—the effects of

[1] Appendix, p. 13789.
[2] Appendix, p. 13835.

changes in volume upon average cost, and the effects of all factors taken together.

Dr. KREPS. Wouldn't you like to add to that, if you were an executive of the Steel Corporation, you might be looking around to see whether you had maintained your efficiency?

Dr. YNTEMA. Yes; we should add——

Dr. KREPS (interposing). Wouldn't this sort of a chart, sort of arrest the attention of executives and make them wonder whether the efficiency of their operations was quite as great as it had been a few years previous?

Dr. YNTEMA. Well, I am not competent to appraise in any way the efficiency of operations in the steel industry.

Dr. KREPS. At any rate, you have made no correction of any kind for efficiency, have you?

Dr. YNTEMA. This is true: Yes; we have in some of our studies made a correction for efficiency, and there has been a definite downward trend in costs in the Steel Corporation which I think can be attributable only to increases in efficiency, and that is shown in the material presented in "Exhibit No. 1416,"[1] entitled "An Analysis of Steel Prices, Volume, and Costs—Controlling Limitations on Price Reductions." There is a downward trend in costs over the period studied, which does reflect the increases in efficiency.

But to come back to this—this actual cost per ton of products shipped would have been higher at this point if there had been no increases in efficiency. This represents the net effect of all factors, and if there had been no increase in efficiency, this cost line, starting from 100 here (this is an index number), would not have been as low at the end as it actually was. This does represent a considerable increase in efficiency, in comparison with the effect of other factors.

Dr. KREPS. An efficiency which did not, however, actually lower actual costs?

Dr. YNTEMA. No. The point is this, that the increase in efficiency was a component tending to bring down average costs. The increase in efficiency was not as great as the increase in other costs, particularly wage rates.

I think it is beyond doubt true that the wage rates in the Steel Corporation have gone up faster than the efficiency of production, and that is the primary reason why the costs per unit of product are higher in these latter years than they were in the earlier years.

Dr. KREPS. You have charts, I take it, that show the break-down of costs and show the increasing efficiency?

Dr. YNTEMA. That is, as I just said, presented in a summary fashion in "Exhibit No. 1416." We have not made extensive studies with reference to that. I personally am not competent to pass on the subject, because that would require——

Dr. KREPS (interposing). I missed the detailed study. I did see the assertion.

Dr. YNTEMA. Yes. The group with which I worked simply is not competent to engage in a study of that sort, and if you wish to request someone, Mr. Fairless or someone from the Steel Corporation, who is competent to respond to that question, I am sure he would be glad to do so. But I don't feel competent to answer the question.

[1] Appendix, p. 14032.

If I may come back to chart C–25 in "Exhibit No. 1409" [1] the double line represents, then, what the costs would have been, allowing for changes in wage rates, tax rates, and efficiency, but eliminating the effect of changes in volume. Now, it is subject to deficiencies, but on the other hand, it is as satisfactory a result as we could obtain, and we have shown you how we have obtained it.

We have also plotted here in the third line the composite mill net yield to the Corporation. This represents, as satisfactorily as we have been able to obtain it, a measure of the price levels of the products sold by the Corporation.

Now, the point was made earlier that the price level paid by those who buy the products may be slightly different in its behavior from the price level of the prices obtained by the Corporation. Those differences, in my opinion, are negligible. It is the differences in the fluctuations of those series, I think, that are negligible, and I believe this is a satisfactory picture.

Mr. FELLER. May I ask a question?

Dr. YNTEMA. May I go on one moment to complete this so we won't break the structure of the argument?

Mr. FELLER. I would like to interrupt you, if I may, to get on what basis those two lines were plotted. You said the products sold by the Corporation—you mean the steel products, or all products?

Dr. YNTEMA. The composite mill net yield covers only the steel products. On the other hand, "only the steel products" includes the great bulk, all but a relatively small percent, of the goods and services sold by the Corporation.

Mr. FELLER. That line which is above, designated actual cost——

Dr. YNTEMA (interposing). That represents all costs of all products. The reason we have not——

Mr. FELLER (interposing). And of all subsidiaries?

Dr. YNTEMA. And of all subsidiaries.

Mr. FELLER. Including transportation systems?

Dr. YNTEMA. Including all subsidiaries.

Mr. FELLER. That's all. I just wanted to get that clear.

Dr. YNTEMA. The reason for handling the problem this way is that any separation would involve an arbitrary allocation of costs. It would also involve a tremendous amount of work. I don't think that if you made the separation the results would be substantially different from these.

Mr. WOODEN. Dr. Yntema, did you have access to any unit costs of production, or did you make any study of the changes in unit costs as compared to the labor costs per unit of production?

Dr. YNTEMA. What do you mean by unit costs of production?

Mr. WOODEN. Per ton cost of production.

Dr. YNTEMA. You mean the average costs of production per ton?

Mr. WOODEN. Yes.

Dr. YNTEMA. Yes, I have seem some of those. In such a case, in case of any manufacturing operations, where there are multiple products produced, it is possible to make some fairly satisfactory study of the costs immediately associated with each process, but when the overhead is allocated, the allocation becomes arbitrary. We were interested in this study not just in the direct costs, but in all the costs of operation, so although I have seen some of the unit costs and I

[1] Appendix, p. 13835.

have studied the behavior of mill costs to some extent, those were not appropriate for this particular problem and we have not presented them to the committee. In fact, I don't think that they are in form to be particularly illuminating on the problems which concern the committee and we have chosen from our material that which we thought would be most useful to you.

If I may continue, this third line is an index of the composite mill net yield of steel products. It is the best index we have been able to present, showing the price level of the prices obtained by the Corporation. This chart is important because of the light it throws on price flexibility. When you talk of price flexibility, there are, of course, many criteria which you might use. You might talk of price flexibility with respect to what the prices have been or were at some later time, or you might talk of price flexibility in relation to costs.

This, in a sense, is a picture of price flexibility in relation to costs. As we proceed from 1929 to 1932, we see that the actual average cost per ton went up sharply, and that the average mill net yield declined. We find, however, that the cost prices, that an index of the cost prices, if I may use that term, did not drop as much as the prices which the Corporation got for its products. In other words, the Corporation, during the depression, dropped the prices for its products more than the prices which it paid for the goods and services which it used in the production of those products.

It suffered, therefore, on two counts: First, because the price level, or the prices of products and services which it sold, dropped more than the price level of the products and services which it bought; and second, because of the decrease in volume, which meant that the overhead or fixed cost was spread over a smaller number of units.

To come back to an earlier question which we should make perfectly clear in this connection, these do not represent prices or cost per unit. It is not possible in the chart in this case to represent those, for the reason that the units are not the same. We took 1926 as a base. In 1926, the Steel Corporation realized 6.2 percent return on its investment. We have not taken, therefore, I think, an unreasonable base for the chart.

If this black line and this dotted line had remained at the same level, and allowing for any possible imperfections in this index number, since we do not claim it to be absolutely perfect, the return on investment would have stayed approximately at 6.2 percent. The return on investment dropped and became negative because costs went up in relation to prices in this period.

In 1937 there was a profit available, again because the average prices rose up to meet the average costs. I think this does afford some interesting evidence, at least, on the general problems of price flexibility.

Acting Chairman O'CONNELL. Dr. Yntema, if I may interrupt you, would this be a convenient time to recess? Are you through with this particular chart?

Dr. YNTEMA. This is almost the end of my statement.

Acting Chairman O'CONNELL. Then would you care to conclude?

Dr. YNTEMA. Yes. In brief, our studies show that the demand for steel is determined primarily by general business activity, consumers' income and industrial profits, and to only a minor extent by the price of steel. The elasticity of demand for steel is so low that a reduction

in steel prices does not provide an effective means of increasing production and employment in the industry. Because of this inelastic demand and the character of costs in the industry, a moderate decrease in price results in a great decrease in profits or increase in losses. Since margins of profit in the steel industry during the past 10 years have been and still are extremely low, no substantial reduction in steel prices could have been borne or could now be borne by the industry without corresponding reductions in costs. This could not be effected without great reductions in wage rates.

Dr. KREPS. You should say by the Steel Corporation, shouldn't you?

Dr. YNTEMA. No; I should say by the steel industry. According to the figures which are submitted in your own record, the average earnings in the steel industry have been extremely low in the last 10 years.

Dr. KREPS. For all the plants?

Dr YNTEMA. Not for all the individual plants but the average for all of them is extremely low. I think that is a mild statement.

Mr. BALLINGER. Very high perhaps from 1901 on to 1930?

Dr. YNTEMA. I am not talking about that; I am talking about things as they are in this particular statement.

Dr. KREPS. Your evidence, in other words, does not show that this is true for the industry; it does show that it is true for the Corporation?

Dr. YNTEMA. No; we are referring to figures submitted in the record by your own research group on this particular point. We didn't think it necessary to supplement that.

Dr. KREPS. But your comment concerns what you believe has been inserted in the record about other corporations?

Dr. YNTEMA. It is my comment on what has been inserted in the record, and also my comment as to what I believe to be the facts of the case on the basis of such evidence as is available to me

A substantial reduction in prices could not be effected without great reductions in wage rates.

Mr. BALLINGER. Dr. Yntema, do you know how many industries in the United States there are in which steel is a factor in cost of production? I mean, steel is sold to them as their fabricating product and the purchase of steel is a factor in production.

Dr. YNTEMA. I should say there are practically no industries in the United States in which steel is not used, either as a raw material or in the form of machinery, but I think it ought to be added immediately that the cost of the steel, in proportion to other costs in most of those industries, is negligible, and even in the case of the major steel consuming industries, the proportion of the cost of steel to the other costs is very low; it is very low, as we have pointed out.

Acting Chairman O'CONNELL. Dr. Kreps, do you intend to recall Dr. Yntema?

Dr. KREPS. Yes; I should like to recall Dr. Yntema after we have heard certain other witnesses. Before dismissing, Dr. Yntema, I should like, on behalf of all of us who have examined the data, to express high tribute, not only to the United States Steel Corporation but to Dr. Yntema personally, for the many new items of information which they have given to the committee and to economists and businessmen throughout the country.

If I may, I should like to summarize some of these for the committee. New information has been made available in three fields, those of costs, prices and labor. As you have noticed, the material on costs not only presents break-downs which are entirely new, but even some that are probably unknown to most firms in the industry at least in the form in which they have been presented. Some of the items shown are, first, total costs of the Corporation after the elimination of results of intercompany transactions; break-down of the costs into a number of components, that is, taxes, wages, material costs and depreciation, and a measurement of the year-to-year changes in these cost factors.

Closely associated with this new break-down of cost figures is the additional information furnished on income from operations; also adjusted for inter-company transactions. In the field of prices, the outstanding contribution in our judgment is the making available of data on actual mill nets, hitherto, of course, regarded as roughly corresponding to prices. There has been a long, and I think rather sterile, controversy concerning the degree to which these published prices actually represented prices paid. The new materials on the mill nets received by subsidiaries of the United States Steel Corporation give this information not only for steel in general, but for various types of steel. This goes far beyond any previously published data and should make unnecessary extended continuation of much of the dispute concerning the significance of published prices.

Similarly in the field of labor, there are new break-downs of wages and employment, and new information extending over a number of years on hours, wage rates and weekly earnings of employees.

I should like to have it distinctly understood that what we now propose is nothing else than a cooperative examination and an exploration of this new and vital information. Whatever differences there are, are largely differences of evaluation. They can be classified into three groups: First, we question, or rather, we want to examine the adequacy of some of the assumptions. Part of that has already come out in this morning's discussion. Our next witness, Dr. deChazeau, will dwell on that topic.

It is important constantly to keep in mind that the mathematical techniques used depend upon and are determined by the economic hypotheses, or economic assumptions, which one makes. For mathematics is just a hopper which grinds out more or less finely what one puts in. We believe that if one accepts Dr. Yntema's arbitrary and limited economic assumptions as being adequate and valid for the committee, that is, if the committee does not consider any other assumptions but those, then little substantial modification is possible in the presentation by Dr. Yntema as given to the committee.

Secondly, we shall want to examine various aspects of certain of the cost items. Finally, there are a few things that should be pointed out about the correlation techniques. But I hope that nothing that shall be presented by the witnesses who are to come will in any way detract from this tribute which we collectively wish to make to the Steel Corporation and to Dr. Yntema. We will call Dr. Melvin deChazeau this afternoon.

Mr. Wooden. I have a few questions I would like to ask of Dr. Yntema. May that be postponed until the first thing this afternoon?

Acting Chairman O'Connell. Dr. Kreps, had you intended recalling Dr. Yntema?

Dr. Kreps. Dr. Yntema will be recalled, because it is our proposal, Mr. Chairman, after Dr. deChazeau has presented his statement, to ask Dr. Yntema to make comments. In fact, it is our proposal that such a procedure be followed for each of the witnesses. This is a cooperative exploration. There are large areas of debatability and legitimate differences of opinion. It is difficult to appraise new information. Pioneering efforts are always subject to reevaluation. We would really like to know what it is we have on our hands.

Acting Chairman O'Connell. Mr. Wooden, would you prefer to have Dr. Yntema recalled immediately after lunch for your questions?

Mr. Wooden. It makes no difference.

Acting Chairman O'Connell. Then since we are going to have Dr. Yntema a little later on, let's recess and hear Dr. deChazeau after lunch. We stand in recess until 2:30.

(Whereupon, at 12:40 p. m., a recess was taken until 2:30 p. m. of the same day.)

AFTERNOON SESSION

(The hearing was resumed at 2:35 p. m., on the expiration of the recess.)

Acting Chairman O'Connell. The committee will please be in order.

Dr. Kreps.

Dr. Kreps. Mr. Chairman, before we resume the steel hearings, I should like to finish the presentation of the cartel hearings, because due to the death of Senator Borah, the senior senatorial member of the Temporary National Economic Committee, its cartel hearings were ended before it was possible to place the last witness, Dr. Rudolf Callmann on the stand. Dr. Callmann, now residing at 23 Hammond Street, Cambridge, Mass., is an internationally recognized authority on cartel problems.

For the 10-year period just prior to 1936, when he was attracted to the United States, he was Rechtsanwalt am Landgericht in Cologne, Germany, engaged in legal consulting practice for a variety of German cartels. Prior to that time, for a period of 4 years, he was managing director of the firm, Rollmann & Mayer, a shoe manufacturing concern at Cologne. In addition, he is the author of a number of authoritative writings on cartel and related problems, most important of which are his volumes on unfair competition, entitled "Der Unlautere Wettbewerg (J. Bensheimer, Mannheim-Berlin-Leipzig, 1932), 670 pages, and his treatise on German cartel law entitled, "Das Deutsche Kartellrect" (Philo Verlag und Buchhandlung GMBG, Berlin, 1934), 721 pages.

I should like to submit his statement, prepared and sworn to by him, for the record.

Acting Chairman O'Connell. It will be included in the record of the cartel hearings, without objection.

(Dr. Callmann's prepared statement on "Cartels" appears in Hearings, Part 25, p. 13347 et seq.).

Dr. Kreps. The first witness for the T. N. E. C. portion of the hearings,[1] whom I should like to summon, is Dr. deChazeau.

[1] Hearings on the steel industry, included in Hearings, Parts 26 and 27, were presented by the staff of the Temporary National Economic Committee, by the Department of Justice, and by the Federal Trade Commission.

(Senator King assumed the Chair.)

Acting Chairman KING. Have you been sworn?

Dr. DECHAZEAU. Yes, sir.

TESTIMONY OF DR. MELVIN G. deCHAZEAU, PROFESSOR AT THE UNIVERSITY OF VIRGINIA, CHARLOTTESVILLE, VA.—Resumed [1]

Dr. KREPS. Dr. deChazeau, for the purpose of the record, will you state your full name, please?

Dr. DECHAZEAU. Melvin G. deChazeau.

Dr. KREPS. And you are now on the staff of the University of Virginia?

Dr. DECHAZEAU. Yes; I am a professor there.

Dr. KREPS. How long have you been studying problems of the steel industry?

Dr. DECHAZEAU. Beginning in 1934, at which time I joined the staff of the Bureau of Business Research of the University of Pittsburgh for a study of the steel industry.

Dr. KREPS. You are co-author of two volumes entitled "Economics of the Iron and Steel Industry," published by McGraw-Hill Book Co.?

Dr. DECHAZEAU. I am.

Dr. KREPS. In doing the research required, did you have a staff at your disposal.

Dr. DECHAZEAU. Yes.

Dr. KREPS. Did you make field trips and did you go through plants and did you consult with a number of steel executives?

Dr. DECHAZEAU. We did.

Dr. KREPS. That, I take it, is stated in full in this rather lengthy preface under the heading, "Obligations to Members of the Steel Industry"?

Dr. DECHAZEAU. Yes.

Dr. KREPS. You have a statement which you have prepared for the Temporary National Economic Committee on the material submitted this morning by the United States Steel Corporation?

Dr. DECHAZEAU. I have.

Dr. KREPS. Will you please give that statement?

Dr. DECHAZEAU. I would like to preface my remarks with a general observation. I do not consider myself qualified as a statistician to criticize in detail the technique employed by Professor Yntema. That will be reserved for Dr. Bean and for Dr. Ezekiel. My remarks, therefore, are in the nature of—if I may presume to say so—attempting to present a point of view for the evaluation and significance of these results.

In the course of my paper, I refer to some possible technical objections which will be developed more fully later.

THE CORPORATION'S ANALYSIS OF COST IN RELATION TO VOLUME

Dr. DECHAZEAU. The United States Steel Corporation through its subsidiaries is the most highly integrated steel corporation in the industry. It has always been supposed that the more thoroughly integrated any organization became—that is, the more completely it

[1] Dr. deChazeau's previous testimony on the iron and steel industry appears in Hearings, Part 19.

insulated the various stages of production and distribution from the market—the larger would be its relatively fixed costs in comparison with its variable costs.

This result was expected to follow not only because of heavy capital investment and the necessary size of the corporate structure but also because an integrated structure precluded the transformation of fixed into variable costs which open market trading at each level of production provides. The Corporation's analysis of costs and volume is startling, therefore, in its apparent demonstration, both that marginal or differential costs are constant over all observable rates of output up to practical capacity and that variable costs per ton are so high relative to prices received that the possibility of price reduction without out-of-pocket loss is of negligible significance.

I should add here that I am not so much surprised that the variable costs are found constant in the steel industry as I am surprised at the level of those variable costs. That is, in an industry in which increases in output take place not through varying the rate at which equipment is used but rather in bringing new items of equipment into use, one would expect a certain uniformity in variable costs with increases in output. The thing that does startle me, and the thing which is crucial, it seems to me, in this analysis, is the level of the variable cost with relation to the fixed cost.

This conclusion is so important for public policy that it must be examined very critically and exhaustively before it can be accepted at its face value.

Acting Chairman KING. You don't mean, do you Professor, that business organizations, whether they are integrated, or rather, decentralized, don't know what their costs are?

Dr. DECHAZEAU. Oh, no.

Acting Chairman KING. They have their balance sheets; they know what the cost of materials are which they purchase?

Dr. DECHAZEAU. Yes.

Acting Chairman KING. They know what they have received for their sales?

Dr. DECHAZEAU. Yes.

Acting Chairman KING. They know what their wages are, and at the end of the year, a balance sheet is prepared and they know their losses or their gains. Is that right?

Dr. DECHAZEAU. That is right.

Acting Chairman KING. And in periods of depression or ups and downs in the business world, obviously there must be ridges and mountains and valleys in the activities and the costs and in the profits and losses of corporations largely integrated? That is true, isn't it?

Dr. DECHAZEAU. Yes. The vital thing here, Senator, is not so much the amount of cost but the variations of cost, that is, the distinction between the overhead cost or fixed cost, and those costs which vary with output—that is the thing which is significant for price policy. If the level of the curves shown for total costs were lower—that is, less steep—the total variable cost would be smaller and the elasticity of demand which would make profitable a reduction in price could be much less. Taking the costs as they are given and the figures as given, one would have to have a demand elasticity of close to four before it would be profitable to reduce prices on the basis of the cost discussion given

An elasticity of four, as you know, means that with a given price reduction the quantity taken would be four times what it was before. Such an elasticity is beyond that conceived of by any students of the steel industry, that or perhaps any other industry.

For that reason, it is vital. That is the point to which I refer.

Acting Chairman KING. I had always supposed that businessmen, whether they are running merchandising establishments or steel companies or railroads or automobile plants, knew what their profits were and knew almost daily what their expenditures were, knew whether they were making money or whether they were losing money, and then with their bookkeeping systems plus the experts which they had, businessmen of ability, who had been with many of the institutions for years, would be enabled to evaluate their activities and determine a proper allocation of all of the factors that were involved in expenditures, profits, and losses.

Dr. DECHAZEAU. Except for the word "allocation," I should agree with you.

Mr. HINRICHS. Well, the word "allocation" is very vital there, is it not?

Dr. DECHAZEAU. Yes.

Mr. HINRICHS. That is, you don't question the fact that the figures of cost as given are accurate with reference to total figures?

Dr. DECHAZEAU. No.

Mr. HINRICHS. But the point is that no business organization can know with absolute precision what the distinction between variable and fixed costs is? Those could and will be established through accounting conventions, in which judgment is a very important factor, and it is on that question of allocation that you are raising questions, not with reference to the aggregate figures of expenditure or the aggregate figures of profit and loss; is that correct?

Dr. DECHAZEAU. That is right, with one addition, if I may add it, Mr. Hinrichs. One presumably has a variation of cost here with changes in rate of utilization of capacity, which is derived from an historical study of total costs through the application of the correlation method. In the application of that method, there may be difficulties which throw doubt on the significance of the result from the point of view of how costs do in fact vary with actual changes in utilization.

Acting Chairman KING. Proceed.

Dr. DECHAZEAU. The statistical method employed in this analysis of fixed and variable components of total costs involves (*a*) a classification of total expenses, (*b*) an adjustment of each category of expense to 1938 conditions, and (*c*) an adjustment of volume of output by weighting the tonnage of each class of products sold by the ratio of its average mill costs to the average mill costs of all rolled and finished steel products during the period of 1933 through 1937. With the exception of pay-roll and "other expense" items which were further adjusted for time trend to correct for changes in efficiency, the fixed and variable components in each expense category were then ascertained by plotting annual adjusted expense against weighted tonnage sold in a scatter diagram, fitting a regression line, and extrapolating that line to the base line.

There is always possible error in the projection of a total expense function derived from an analysis of historical cost data. The shape

of the cost function at levels of output below those actually experienced may be different from that within the range of observations. This is of slight importance here since the low rate was 18 percent of capacity, very close to the absolute minimum. In the present case, although the range of observations is wide, the number of observations, especially in the medium range of output (i. e., in the general region of 8 to 10 million weighted tons), which is crucial to the analysis, is very limited or absent—I say crucial because the break-even point is around 8½ million tons. This fact gravely restricts the reliability of the conclusion that the total cost function is linear and renders the probable error in an extrapolation of the regression line to determine the fixed component of costs extremely high. Furthermore, a relatively slight change in the slope of the regression line can make a substantial change in the apparent size of fixed and variable costs. It is possible, therefore, that the actual overhead expense of the Corporation is greater than that calculated by the statistical method employed.

Neglecting this possibility, however, it is apparent that the character of the total cost function and the relative magnitude of fixed and variable components of cost depend on (*a*) the dependence of actual expenses in a given year on the volume of sales in that year; (*b*) the reasonableness of the adjustment to 1938 conditions; and (*c*) the adequacy of the weights employed to obtain a homogeneous single output series. Finally, the significance of the result for pricing policy depends on the applicability of this method of cost analysis to a situation in which multiple plants are employed, multiple products manufactured, and dynamic conditions of technology and capacity obtain.

The data made available in this monograph will not permit an exhaustive or conclusive evaluation of the results from the points of view just enumerated. Criticisms of the data analyzed, the adjustment of data, and especially the weighting of tons are important primarily because of their cumulative rather than their individual effect. Because of the limited number of observations a relatively slight change in the location of points in the scatter diagrams might render the cost function curvilinear rather than linear. The most important limitation on this study, however, is the narrow significance that may rightly be accorded it for the purposes of pricing policy.

Mr. Hinrichs. May I interrupt just a second there? If I understand what you have just been saying, it is that on the curves that we saw this morning, what you call the regression line here was that dotted line that passed more or less through the points?

Dr. deChazeau. That is right.

Mr. Hinrichs. And that in order to arrive at a figure of $162,000,000 as the total of fixed costs——

Dr. deChazeau. One hundred and eighty-two million dollars.

Mr. Hinrichs. It was necessary to extend that line back to the theoretical point of what costs would be even if there were no production. Mr. Yntema made reservations this morning and wouldn't say that those costs actually would prevail at zero production, but that for practical purposes it was necessary to extend that line back to the idea of a zero base line; that Mr. Yntema this morning said, if I remember correctly, that he didn't attach much importance to the extrapolation, but in fact it has a very real significance to the points that he was making because it is only when it is extended back that

that figure of $182,000,000 comes out of his figures. Now anything that happens to the slope of that line, even if it involves a relatively small shift one way or another, might very well make that figure $200,000,000 or $150,000,000, and that you are directing your attention, therefore, to the question of comparatively minor differences, possibly within the range of observed fact, but trying to see how variations in this area of observation would affect the guess that you have to make as to what the total volume of fixed costs is back there on the line of zero production. Is that correct?

Dr. deCHAZEAU. That is true so far as the point with relation to extrapolation is concerned.

Mr. HINRICHS. And if you were to have, instead of a straight line, a line which curved, it would be characteristic of a curve that it would drop away very fast as it came back to that base line and flatten off as you went out at the top. That is also correct?

Dr. deCHAZEAU. Yes; and of course if your total costs described a curve instead of a straight line, that would affect your conclusion that the variable costs were uniform.

Acting Chairman KING. Is it your contention that when the books show a deficit there during a period of $182,000,000, the mine owners didn't know what they were doing, didn't know anything about it, didn't know what it represented, and what caused it?

Dr. deCHAZEAU. Senator, my point has nothing to do with profits or losses. What I am interested in is whether the variable costs are in fact uniform, and, second, how large they are with relation to the total costs.

Acting Chairman KING. When you speak of variable costs, do you mean, taking the industry now under consideration, the cost of iron ore?

Dr. deCHAZEAU. I mean the additional costs which are associated with additions to output, which is the variable costs as Dr. Yntema discussed them this morning.

Acting Chairman KING. Well, the costs of operations vary from day to day and from month to month and from year to year in any industry, don't they?

Dr. deCHAZEAU. Quite right.

Acting Chairman KING. The cost of your ore one year may be considerably different from the costs of ore for a preceding year, your labor costs vary. Those are variable, aren't they?

Dr. deCHAZEAU. Yes, sir.

Acting Chairman KING. And there are many factors incident to the determination of your outgo and your income that are variable market conditions, labor conditions, cost of raw materials, and the prices of finished products all go into the sum total of your conditions with a view to ascertaining just what the situation is and what the condition of your business is.

Dr. deCHAZEAU. It is all of those conditions which Dr. Yntema was analyzing, eliminating variations in price by adjusting to 1938 conditions.

Acting Chairman KING. You are not attempting to show that those figures which were given as to the costs, losses, and so on, were inaccurate?

Dr. deCHAZEAU. In no sense.

Acting Chairman KING. Yours is a sort of scientific technological discussion of things which the practical man doesn't know anything about.

Dr. DECHAZEAU. I hope that that is not true, Senator.

Dr. KREPS. May I point out, Senator, that this line which summarizes the experience of United States Steel does not extend below slightly over 4,000,000 tons. There is nothing in the experience of the Corporation which indicates what their fixed costs are below that level. Therefore, the $182,000,000 figure which they arrive at is a guess, and a guess arrived at by extrapolation. That guess represents no common sense experience. Yet if fixed costs are not relatively small, and in particular if variable costs, instead of rising steeply, rise slowly, then the whole of Dr. Yntema's further analysis falls by the wayside.

Acting Chairman KING. Is that testimony that you are giving now, Doctor, or comment upon the testimony?

Dr. KREPS. I want to clarify the issue in this case.

Acting Chairman KING. It may be clarified, but I haven't been clarified. Proceed.

Dr DECHAZEAU. Senator, I wonder if I could clarify the situation by merely indicating this. If the points in the scatter diagram from which the regression line was derived, were shifted slightly to the right by change in the weighting in the latter years and slightly to the left in the earlier years, that would have the effect of requiring a fitted line to those points which would rise much less rapidly and which would cut the base line at a higher fixed cost level. The result would be that your figure for variable costs would be less than it is here estimated. Hence the position of the points in the scatter diagram is very important for the analysis, because as the variable costs fall the elasticity of demand required to make it profitable to reduce price is much less. That is the only point here considered. I am in no way challenging the figures used by the Steel Corporation.

The relation of recorded expense to volume of sales may reflect managerial policy rather than actual cost and thereby exaggerate the apparent magnitude of variable costs.

The arbitrary character of accounting cost allocations with particular reference to this analysis will be discussed before this committee by Mr. Martin Taitel and need not be examined in detail by me. The tendency to allocate costs to years in which there are receipts sufficient to cover them is well known. To the extent that these charges are excessive in good years and less than "true" costs in bad years, a bias will be given to any total cost function derived from an historical series which tends to overstate marginal with relation to fixed costs and may impart an erroneous linearity to the function itself. Possible examples are bonuses to executives associated with with changes in the level of sales; depreciation (as well as debits to other reserves); the purchase of supplies, materials for repair, and so forth. The point is important primarily because of the size of the pay roll and the "other expense" items. These two items constituted, during the period analyzed, almost 84 percent of aggregate unadjusted expenses before income taxes, while "other expenses" alone (a lump item without any breakdown in the analysis), accounted for roughly 38 percent of the aggregate. These items so dominate

the final results that the conclusions can hardly be admitted without more detailed analysis of the components which went into them.

Probable error in the adjustment of pay rolls and "other expense" to 1938 conditions, because of the dominating importance of these items, is sufficient to throw doubt on both the linear character of the total cost function and the magnitude of the variable costs.

Two adjustments were made in pay roll data: Average hourly earnings were raised in each year of the period to the average for 1938 ($0.902) aud the adjusted pay roll was then corrected for time trend to give effect to increasing productivity. But the first adjustment assumes that the same composition of skills is used at every scale of output. The proportion of skilled persons employed, however, is likely to be greater at lower rates of output. This may be the reason why the Corporation shows approximately the same average hourly earnings in 1931 as in earlier years despite reduced rates in 1931 and lower average hourly earnings in 1933 than in 1932 despite higher rates. The importance of this factor cannot be ascertained a priori. Since most skilled workers in a steel plant work on piecework with a guaranteed hourly minimum, the effect of variations in the composition of the staff on average hourly earnings is modified by the variation in earnings of skilled workers with variations in output.

With reference to this point, information which the Steel Corporation made available just last night, in which they tested hourly earnings with relation to output over a period from April 1937 through the current month of 39, indicates that there is not much variation in hourly earnings with changes in output. I am not at this time prepared either to criticize or to accept without reservation those particular results. The method of adjustment employed, however, tends to increase the slope of the regression line and therefore to raise the apparent variable costs.

The adjustment for time trend (table 20 and chart 8 in "Exhibit No. 1416"[1]) seems particularly unconvincing. Instead of a single line of regression, three appear to be indicated. From 1927 through 1929, although total pay roll remained about the same, output increased, and, contrary to expectations, if variable costs were in fact constant, the "trend in residuals" showed an increase in efficiency of about 15 percent. From 1930 through 1933, a separate regression curve is indicated. Whether by reason of faulty wage adjustment for changes in the composition of the labor force or because of technological changes, an increase of efficiency of over 10 percent is shown. Finally, a third line from 1934 through 1937, while output was expanding and technological changes were being made, suggests another gain of over 15 percent. These gains were not cumulative throughout the period. In the absence of a break-down in pay-roll figures and of a continuous trend of residuals during the period, the conclusion that pay-roll data conform to a linear function is far from certain.

The adjustment of "other expenses," without knowledge of its component items, is even more suspect. Since its magnitude is comparable to that for pay rolls, the indicated increase in such adjusted expenses over the period by 10.47 percent of average implies that the gains of labor-saving technology (equivalent to 14.41 percent of average pay roll) were largely nullified by such adjusted "costs."

[1] Appendix, pp. 14051 and 14052.

The assumptions that must be made to justify the weighted tons employed in the analysis are so improbable as to throw doubt on the conclusions derived.

Costs, for the purpose of this analysis (except for nonoperating income and expense), cover all operations of the Corporation's subsidiaries of whatever nature while sales are represented by weighted tons of all products shipped (except cement and certain liquid and gaseous coke-oven byproducts)—somewhat less than the full volume of business represented in costs by the amount of goods and services sold which are not measured in tons. This conglomerate is reduced to a "homogeneous" number of equivalent average mill-cost units called "weighted tons" by correcting the actual tons of each product shipped in each year by the ratio of its average mill costs to the average mill costs of all rolled and finished steel products over the period 1933–37. No data are presented which would enable one to appraise (*a*) the comparability of the cost items included in mill costs for different products; (*b*) the representativeness of the average for each product in terms of the range of mill costs at a given plant over time or between plants at a given time; or (*c*) the stability of the standard adopted, that is, the average of mill costs for all rolled and finished products at all plants over the 5-year period.

Assuming the propriety of the mill-cost averages, however, it is necessary to assume also that the ratio of the average mill cost of each product to the average mill cost of all rolled and finished steel products during the sample period 1933–37, was constant throughout the period analysed, 1927–38, inclusive. This is equivalent to an assumption that no technological improvements took place in one department or geographic area that did not take place in all departments or geographic areas. That this was not true as between steel and nonsteel products may be discounted because of the relatively small ratio of weighted tons of nonsteel products in total weighted tons. But the same can hardly be said for hot and cold rolled light steel products like strip, sheet, and tin plate which constituted a substantial and apparently increasing percentage of the total tonnage of rolled and finished steel shipped during the period. If, as seems likely, there has been a downward trend in the mill costs of such light flat-rolled products relative to the average of all rolled and finished steel products over the period studied, the weights actually employed would reduce the weighted tons in earlier years.

The range of actual adjustment is fairly large—the spread of the correction factors being about 10 percent. Practically all of the high volume years are corrected downward while the low volume years are corrected upward. This results from the relatively greater proportion of high value products like sheet, strip, and tin plate shipped in low volume years. Were correction made for a downward trend in mill costs for flat-rolled products the points in the scatter diagram would be shifted to the right especially for the earlier years of the period. The net effect on the slope or on the linear character of the regression line cannot be determined for lack of data. Admittedly, however, a substantial change in weights would be required to make a significant change in results.

SIGNIFICANCE OF THE COST STUDY IN PRICING POLICY

Dr. deChazeau. The cost relations traced in this statement are primarily static costs and cannot be used to measure the change in costs that might be expected as the Corporation moves from one level of output to another, the essential factor in pricing policy.

This, I think, is one of the most important criticisms. By correcting cost items to 1938 levels, it was apparently desired to estimate from an historical cost series the variation of costs with changes in the rate of utilization of capacity at a given time. But despite substantial changes in capacity over the period studied, no correction was made in the weights (and therefore the output measurements) for variations in the percent of capacity operated. The cost-output relation sought was one applying to a specified set of capacities while the cost figures used apply to different sets of capacities at various times. Much of the so-called variable costs in this analysis may be found, on closer examination, to reflect changes in capacity to produce.

Although there is reason to believe that costs behave differently depending on the direction, and the rate of change in output level as well as the preexisting level of output, no consideration was given to the effect of such factors. Suffice it to say that there is some internal evidence that such was the case with relation to pay rolls.

It was tacitly assumed that long-run and short-run costs for a given output are the same, that is, that adaptation takes place at an infinite rate. This result, of course, is implicit in the use of annual rather than monthly or quarterly data. The use of annual data, undoubtedly was forced on the Corporation by the character of the cost information available.

The cost curve finally developed can be admitted as a limitation on pricing policy only on assumptions which the industry has rightfully denied and which falsify the dynamic character of costs.

The procedure employed in this study is most appropriate for a single plant producing a single product. For many plants producing a wide variety of products, having no inherent homogeneity, it can provide only the roughest kind of approximation at best and it is downright misleading at worst.

The steel industry has long taken the position (and rightly so in my judgment) that—

(*a*) Costs are not comparable between plants and areas since they vary not only with the prices of the factors but also with the combination of products manufactured.

(*b*) Cost even for a given product at a given mill will vary from time to time with the combination of specifications rolled.

(*c*) The steel industry produces a multitude of special tailor-made steel products with widely diverse costs.

We are now asked to believe that an analysis of the total historical expenses of the United States Steel Corporation, covering some 50,000 steel products and a multiple of nonsteel products and services ranging from cement, coal, and iron ore to byproducts, transportation services and construction, may be assumed to represent the cost situation that confronts the Corporation in making a price for a given steel product.

At least I take it this is the implication of Dr. Yntema's remarks.

Acting Chairman KING. You would expect, would you not, in fixing the prices for their various commodities, that they would take into account the general activities in which they are engaged?

Dr. DECHAZEAU. Quite.

Acting Chairman KING. It would be impossible to segregate one little strand, so to speak, of the great fabric and say the cost for that little one strand out of perhaps thousands of strands shall be so and so.

Dr. DECHAZEAU. That is right.

Acting Chairman KING. You have to take into account the entire pattern.

Dr. DECHAZEAU. That is right.

Acting Chairman KING. And you have to take into account the cost of the ore, the cost of shipping it, you have to take into account the repair to the plants, the labor costs which change from day to day and from month to month, the fluctuations of the market, the changes in demand, and a multitude of factors which every businessman reluctantly or otherwise is compelled to meet and to adjust himself and adapt himself and his business to those changing conditions.

Dr. DECHAZEAU. That is right. I did assume, however, Senator, that Dr. Yntema's remarks had reference to pricing policy. If they have merely reference to the fact that the Corporation makes losses, at certain levels of output, at certain levels of price, that is a different matter and restricts its significance considerably, but with relation to prices it seems to me that one must of necessity consider these other factors.

Acting Chairman KING. You do not contend, do you, that every business, whether it is steel or the grocery business, is going to have profits entirely and in determining year in and year out the business which he is conducting and the prices which he shall charge and all factors, he has got to take into account losses as well as gains, good years as well as bad years.

Dr. DECHAZEAU. Yes.

Acting Chairman KING. Dark days as well as sunshiny days.

Dr. DECHAZEAU. I should agree that he must take those things into consideration.

Since the location of the points in the scatter diagrams depends on the number of weighted tons shipped in each year (i. e., the weight accorded the actual tons of each product shipped) and the location of these points determines the regression line (and, therefore, the character of variable costs and the relative magnitude of such costs), it must be assumed that the ratio of fixed to variable costs for the average of all rolled and finished steel products is not only characteristic for each of them but also characteristic for all other goods and services supplied by the Corporation. But this is absurd. What are variable and what are overhead costs for a particular product at a particular time depend on the alternatives available to management. An integrated plant has capacity to roll a large variety of steel products and a large proportion of the costs of any one is common to the rest in the rolling and finishing operations and especially in prior processes such as steel-making and pig-iron furnaces. When the rate of utilization of capacity falls, it does not fall uniformly for all products and all departments; and no matter how low it may fall for the plant as a whole, there are technological obstacles to reduction in some depart-

ments below the minimum capacity of operating units (e. g., blast furnaces). The additional costs of rolling or processing a particular product or a particular specification of a product will vary widely at a given plant and between plants depending on such factors as level of output, combination of products and specifications, rate of change in output, and so forth. In other words, at a given time, practically all costs may be overhead so far as a given product is concerned.

Why doesn't this condition, the real scope for managerial discretion in the allocation of existing business to obtain lowest costs, reveal itself in the cost analysis under consideration? The use of an average, even a weighted average, of all goods and services sold by the Corporation, together with total expenses, is the obvious reason. A very wide diversity in the cost characteristics for individual products may be completely compensated in the over-all picture. In other words, the behavior of the aggregate bears no necessary relation to that of any one of its parts, and therefore its significance for the pricing of any given product is indeterminate. Together with limitations on the validity of conclusions previously outlined, this means that the use of such a cost analysis as a criterion for or a justification of pricing policy cannot be accepted.

Mr. Hinrichs. Mr. Chairman, may I interrupt at this point? I haven't the faintest idea what you have been talking about here. Let me go back for just a minute and see if I can see the points that you have covered. I thought I knew something about this too. First of all, you say that where you have a wide variety of products, a wide scattering of plants, the over-all picture is necessarily confusing, that you could make a detailed analysis for a given plant and a given product with far more certainty than you can make an overall analysis for the Steel Corporation. Is that correct?

Dr. deChazeau. Yes.

Mr. Hinrichs. Now, then, no one quarrels with that, least of all, I presume, Mr. Yntema. Then you go ahead and you say that it follows from this that you can't draw any conclusions from average price relationships or more particularly from aggregate cost relationships to aggregate production relationships. It is necessary, is it not, for a business enterprise that is making a sensible approach to a question such as the question that is raised here as to general pricing policy, to arrive at what you have described as a rough approximation of what those over-all relationships are. That would be true, would it not?

Dr. deChazeau. Yes; I should say so.

Mr. Hinrichs. Do you know of any work which has been done in the field of merging unlike products and costs in unlike plants which is a more satisfactory method of arriving at that necessary approximation than the job that has been done here?

Dr. deChazeau. No——

Mr. Hinrichs (interposing). Are you criticizing this as a defective utilization of methods which have been developed in recent years?

Dr. deChazeau. No. I am interested in whether the method as applied to the entire Steel Corporation, deriving your relation of variable cost to fixed cost from an historical price series, will in fact indicate the extent of the fixed cost with relation to the variable cost, which is a factor of importance, it seems to me, in the pricing of the steel product.

What I am criticizing is whether any such development will in fact show you what that proper relationship is.

Mr. Hinrichs. That is, your conclusion would be that the relationships would be better arrived at through an intimate understanding of price relationships in a given plant for a given product and through a process of deductive economic reasoning rather than through a statistical approach.

Dr. deChazeau. Or a statistical analysis of the operations of that plant rather than a statistical analysis of the operations of the Steel Corporation. Now I appreciate the limitations on Dr. Yntema's work, which he himself pointed out, that he couldn't take an individual plant and make such an analysis. I believe, however, that the committee is interested in this study as it affects the question of price flexibility or possible price flexibility in the industry as a whole. It is from that point of view that I am criticizing.

Mr. Hinrichs. That is, as I understand not only what you are saying in this paragraph, but in others, there are certain points at which elements that were not taken into account by Dr. Yntema, in your judgment, have given a less deep curve than the one that we had, as for example in the general characteristic of carrying in the years of good business a higher proportion of costs than are charged in years of bad business?

Dr. deChazeau. Yes.

Mr. Hinrichs. I think there are other points where you similarly have questioned, out of your experience, the precise steepness of the curve. Now in this connection what you are questioning is the probable error in the final result that comes out when one is using aggregates. What you are saying essentially is a thing which Dr. Yntema would agree with you in, I presume?

Dr. deChazeau. I hope.

Mr. Hinrichs. He would certainly be willing to give you the probable error of his line of regression, to go technical, and what you are saying is that that line or that $182,000,000 can in no sense of the word be regarded as an absolutely fixed established sum, but that in the very materials we are working with it is at best $182,000,000 more or less, and the more or less may be very large.

The second thing that you are saying is that the evidence would be more conclusive if it were substantiated out of a more particular analysis of the cost operations in a particular plant engaged in making a specific product and that the more one refines the product the less statistical juggling one has to engage in, and the more accurate one's final conclusions; is that correct?

Dr. deChazeau. Yes; but may I emphasize the importance of it? Let me repeat. If this cost analysis is taken as not merely representative of the costs of the Steel Corporation, which incidentally is an important factor in the industry, but as representative of steel costs generally (i. e., with relation to the size of variable costs contrasted to fixed costs), the possibilities of price variation, of price reductions in this industry, are practically insignificant and discussions of demand elasticity are highly academic. It is true that Professor Yntema, for his analysis, after deriving a figure of 0.3 to 0.4, assumes 1.0 as the elasticity of demand for steel.

It wouldn't have made much difference if he had assumed 2.0 or even 3.0; the result would be the same, although the magnitude of the

results would be altered. Therefore, it seems to me that before one can accept such a presentation of the costs as being the actual relation of variable to fixed costs, one must know a little bit more than one does at the moment.

Acting Chairman KING. Dr. deChazeau, I am not a professor nor a doctor nor a technologist, but I have some little practical appreciation of the practical problems of life. I confess that I am not very clear as to what you are trying to present for the consideration of the committee, but in order to bring it down to a concrete situation, let me give you—so that I may understand whether I understand you, and whether the matter which we are discussing is susceptible of concrete presentation, and presentation such as the ordinary man would understand—a case of this character. How would you, if you were running the Corporation, fix your cost sheets and make your report in order to determine these variables and ponderables and imponderables, and tangibles and intangibles which have been thrown at us here with great ability?

I have in mind a corporation owning some mining properties. It attempted to work them and failed; costs were too great; it found that it had to build a railroad; it had to ascertain the costs of that railroad and its operation, and it had to build smelters. Those smelters didn't always function properly; many of them had to be changed; new processes, technological processes in the working out of orders were developed, so that a proposition which started out with the expectation of costing only a few million, perhaps cost $75,000,000 before they could make any profit at all.

Then in determining what their profits and their losses were, they had to take into account the costs of operating the mine. That had to be changed. Then they had to take into account the cost of removing the dirt and that cost a great deal. Wages changed. Then came the various acts of Congress under which their taxes were increased. Then came the question of depletion, difficulty in determining just what to allocate for depletion, what claims should be made by reasonable depletion. There were variables there, variables that ranged many percent because some of the scientific men said you could allow only so much for depletion, and others insisted that in view of the fact that they were taking out the ore that capital was being depleted.

Then there were the costs of the railroad and then the cost of the smelters, and the wages differing; all those things; they had a number of integrated organizations all concentrating, though, in the final result at the end of the year when they had to write the balance sheet, all those costs and expenses and losses and profits were found there in that balance sheet. How would you determine what to allocate to the operation of the mine, what to determine for the smelter, the railroad, and so on? How are you going to do it? Is not this a practical thing at the end of the year, the corporation says, "We have expended $20,000,000; we have received $19,000,000. We have a deficit there of $1,000,000." How are you going to allocate that? Would you say they charged too much for the removal of the overhead, they charged too much for depletion; they got too large a credit there and too large a loss there? The company lost it or made it, and the balance sheet showed everything they received and everything they expended for the year, would not that be an honest balance sheet?

Dr. deChazeau. Quite an honest balance sheet.

Acting Chairman King. Wouldn't that be the practical way that a practical man would deal with his business affairs?

Dr. deChazeau. I know that it is bad form for one being asked a question to reply with one, but I wonder if you considered what elements in that cost situation would be necessary elements for you if you were fixing a price?

Acting Chairman King. Well, if I were fixing a price, as they were, upon their cost and determining what their price should be, I would take into account all of the things that I had expended in order to make the copper, though part of it was the railroad, part of it the smelter, and part of it was some other commodity; I would take all those into account and put them into one balance to determine what I had paid out and what my losses had been or my profits.

Then I would fix the price accordingly.

Mr. Feller. I wonder if I might attempt to clarify this? Am I correct in understanding that Dr. Yntema has attempted to present a formula under which it is possible to determine what the return of the Corporation would be from changing the price of steel; in other words by examining the elasticity of demand, the variation in demand which results from the changes in price, and by examining the costs of the Corporation as they appear on their books, he has attempted to produce a formula which will tell the Steel Corporation or perhaps the industry as a whole what sort of price changes to make in order to make more money or in order to lose less?

Now that is a highly practical task and if the task succeeds Dr. Yntema should receive the collective thanks and esteem of the steel industry and a very substantial reward. Now as I understand it, Dr. deChazeau is inquiring into the method of the construction of that formula. Now again I understand one of the critical points in the construction of that formula is in distinguishing between those costs which are fixed, which do not vary with the rate of operation, and those costs which are variable, those costs which change as you produce more or less steel.

Now may I go on and state my understanding?

Acting Chairman King. Aren't you assuming that there is a datum line, no change in certain activities?

Mr. Feller. Exactly, Senator.

Acting Chairman King. Every day.

Mr. Feller. What Dr. Yntema started out to do, was to try to determine those costs which would be there if the Steel Corporation produced only 1 ton of steel. In other words, the very rock bottom of cost. Now the way he did that, as I understand it, subject to correction by Dr. Yntema, was to put down on a diagram the costs, to put a diagram which indicates on the bottom the tons shipped by the Steel Corporation; on the side the total cost of the Steel Corporation; to put down on that diagram a series of dots; each dot indicating the particular results for a given year. Then he took a pencil and drew a line through those dots. Then he extended the line toward the bottom and toward the top and where that line hit the chart he said, "Those are the fixed costs," and he said they are $182,000,000, and when Dr. Yntema comes back on the stand I should like to ask him whether anyone in the Steel Corporation had ever heard of that $182,000,000 before he produced this study.

Now I understand that that is the situation, the issue before the committee.

Acting Chairman KING. I am afraid when professors disagree and lawyers and so on, we will not reach any agreement. I am going to interrupt the proceedings for a moment.

Dr. DECHAZEAU. Since the points which have been raised pro and con at this time will probably be discussed with Dr. Yntema, I think it will be unnecessary for me to say any more at the moment.

If the contentions of the Corporation with regard to cost and demand are admitted, one is forced to conclude that from any break-even point a price reduction will bring losses and an upward price movement will bring continuous and increasing profits.

Briefly, it is the contention of the Corporation that total costs are linear and relatively steep, that variable costs are constant, and relatively large, and that a demand elasticity as great as unity is in excess of anything for which the industry may hope. The Corporation concerns itself exclusively with results which might be expected with a price reduction. But demand elasticity is equally applicable to price increases with a corresponding decline in volume. On the assumption that costs vary by a fixed amount per unit of putput (i. e., that the cost function is a straight line) and that demand elasticity is unity (i. e., that the total sum expended for steel is not affected by a change in price), it is apparent that it would be increasingly profitable to raise prices, disastrous to lower them; and that this situation is enhanced if demand is less elastic than unity (i. e., that a larger total sum is expended on steel at a high than at a low price). The theoretical monopoly price would be at a point which allowed the sale of a single ton.

That this monopoly price would ever be attained or approached is of course absurd. Elasticity of the curve in the vicinity of the break-even point is no indication of its elasticity beyond the range of observed price variations (a limitation of great importance, incidentally, on Dr. Yntema's demand analysis). Price increases are checked by the bargaining power of large buyers (some of which are capable of producing steel for their own requirements), by the potential substitution of other products, by the competition of other steel companies suffering from underutilization of capacity, by the force of public opinion including the threat of Government intervention, and so forth.

The point is made merely to illustrate the inherent pressure toward higher prices in the industry if the cost analysis of the corporation be accepted either as characteristic for itself or for the industry. If, as has been contended, a price cut on important business by any member of the industry will be met immediately by his rivals whether the price reduction is published or not published, the result is inevitable—all sellers are worse off than before. On the other hand, any price increase that can be made uniform throughout the industry, and maintained, will result in gains for all. Accepting the cost data as accurate, it is merely academic to consider whether price elasticity of demand for steel is 0.5, 1.0, 2.0 or even 3.0. The question is inconsequential, for whatever the value of price elasticity within this range the result would be altered only in degree. An elasticity far beyond that contemplated by any student of the problem would be required to make a policy of price reduction profitable.

UNITED STATES STEEL CORPORATION'S ANALYSIS OF DEMAND FOR STEEL

Dr. deChazeau. I turn from a consideration of the cost study to the study of demand. The object of Dr. Yntema's study of demand is exceedingly narrow and its limitations must be borne in mind, especially in any attempt to evaluate its significance, either as a guide to industry pricing policy or as an indication of the relative desirability or possibility of price changes from a social point of view. The price elasticity of demand for steel, which it purports to measure over the period 1919–38, is defined as the percentage change in the quantity of steel that would have been sold in a given year had the average level of steel prices in that year been higher or lower than it actually was by a certain percentage but everything else had been the same. It is this last qualification which limits both the scope of the question and the significance of the conclusion.

I wish to concern myself with three broad issues; namely, certain technical criticisms of the measure of price elasticity of demand for steel derived, the significance of such a concept of demand for industrial pricing policies, the social problem raised by this analysis.

With regard to the first issue, I conclude that the method and data employed have the net effect of reducing the apparent short-run price elasticity of the demand for steel. I should point out here that since the time is limited and since technical issues will be analyzed in great detail by Dr. Bean, and especially because such suggestions as I have would, in my judgment, make no substantial change in the result, I shall pass over these points very briefly and not read my entire manuscript.

In later analyses, a demand elasticity of unity (substantially greater than that of 0.3 or 0.4 derived from this study) is used by Dr. Yntema on general theoretical grounds, there is reason to believe that the short-run price elasticity of demand for steel is relatively low. A correction therefore for the technical defects to be noted by me would probably not make any important change in the ultimate conclusion. This is the more certain if the cost analysis be accepted. The correlation technique, however, is no more than a mathematical grist mill and the significance of the results obtained cannot be greater than the meaningfulness of the basic data which are subjected to this method of treatment.

The measure of quantity sold is an ambiguous and changing aggregate, the use of which tends to reduce elasticity to a minimum.

Dr. Yntema pointed this out himself, and after explaining that individual steel products do not have the same economic importance per unit of weight, they are not subject to the same demand conditions, and their relative character and importance changes from year to year, he proceeded to use an aggregate of such items.

Now the larger the aggregate employed and the more diverse the products included in it, the smaller must be the apparent price elasticity of demand on the assumption that other things are equal. Although substitution of steel for other products and vice versa is likely to be very small in the short run, even for individual products, it is negligible for steel as a whole.

The measure of price change adopted tends to minimize the importance of price in accounting for changes in volume.

Dr. Yntema used the Iron Age finished steel composite, which is an arithmetic average of the published prices of eight steel products at Pittsburgh. As he pointed out this morning, he also ran a later correlation in which he used average mill nets for the Corporation and found that no substantial change took place. It is important to note, however, that the more inflexible the measure of price change adopted (not so much in number of changes as in amount of change), the greater the weight which will be given to factors other than price in accounting for changes in the volume of sales. For example, had there been no change whatever in the measure of price, the correlation technique perforce would attribute all changes in volume of sales to factors other than price.

With relation to the use of mill nets I merely add this point. I accept Dr. Yntema's statement that the use of the average mill nets would not affect the results substantially. I criticize primarily the use of an average which, unless it can be assumed that all prices move together, will cover up the extent of the price change as it may affect any given product, and therefore any given increase in demand. For example, a break in sheet and strip prices around the middle of October 1939, first of $4 a ton, followed later by $2 a ton, which did not represent a general reduction in price of steel at that time, might well have affected an increase in the demand for those steel products, but mill net, the average mill net for all products, would show a reduction which was much less than that for those particular products.

Acting Chairman KING. Well, is there any relation between a reduction in price and general consumption? I know of many instances in which the reduction price of metal didn't make any material increase in the consumptive demands. Does it follow as a rule that when you reduce the price of a commodity there will be a great increase in its consumption?

Dr. DECHAZEAU. It does not always follow as a rule; no.

Acting Chairman KING. The exceptions are very numerous, aren't they?

Dr. DECHAZEAU. Very numerous.

The use of annual rather than monthly or quarterly data eliminates the importance of the rate of price change as an independent variable and, therefore, makes impossible a consideration of the timing of price change. Steel prices are usually announced on a quarterly basis although actual prices, through concessions, may be made from day to day. Annual data eliminate seasonal factors in demand and reduce the importance of speculative buying. But seasonal factors are more properly eliminated statistically to leave, in the monthly or quarterly figures, sales variations which may reflect price change. And speculative buying is an integral part of the demand for steel of admitted importance of the steel industry in the determination of price policy, and of great social importance as well, whenever there is less than full use of resources in the economy. To nullify this speculative factor in demand is to preclude an analysis of the timing of price change with respect to consumer expectations and the demand for durable goods, producers' expectations and the decision to invest, and changes in the prices of substitute and complementary goods.

By his selection of data, therefore, Dr. Yntema is precluded from giving effect to the following factors, crucial in the concept of price elasticity of demand:

(1) The ratio of steel product prices to the prices of substitute materials or products in the manufacture of goods made from steel or in consumption.

(2) The ratio of steel product prices to the prices of complementary goods used in the manufacture of goods made from steel.

(3) The rate of actual price change for steel products with regard to the demand for those products.

(4) The timing of price change with regard primarily to the timing of investment.

A fourth point which I note here I shall pass over immediately. Dr. Yntema worked out his correlation for several relations, that is one on the basis of shipments and one on the basis of bookings, and so forth. I refer specifically to the latter. There is no convincing reason why Dr. Yntema adopts the figure of 0.3 to 0.4 as a maximum potential value of demand elasticity, rather than the figure 0.88 determined on the basis of estimated steel bookings. I shall leave that for Dr. Yntema to discuss.

SIGNIFICANCE OF CONCEPT OF DEMAND FOR INDUSTRIAL PRICE POLICY

Dr. deChazeau. My general conclusion is that, as a criterion of pricing policy for the steel industry itself, the price elasticity of demand measured by Dr. Yntema is inadequate.

Three important aspects of demand require separate analysis as a basis for the pricing policy of any seller: First, the cross elasticity of the demand, by which is meant the percentage variation in quantity of products sold by a given seller with a given percentage change in his price on the assumption that this price is not met immediately by his rival. Second, the price elasticity of the market demand, and third, shifts in the demand for any product at any given price. Dr. Yntema neglects all but the second, the price elasticity of market demand.

There is no error in neglecting cross-elasticity of demand, as I have defined it, for the very obvious reason that, as has been noted many times before this committee, no cut in price can take place among important sellers for important business that is not immediately met by rivals. Under those conditions, each seller must of necessity consider, not the cross-elasticity of demand, but the elasticity of the market demand in determining what price is desirable for him.

An average figure of price elasticity over the period 1919 through 1938 is almost certain to be erroneous as a criterion of price elasticity of demand at any given time.

The demand for producers' goods, either raw materials or capital goods, is a derived demand. In addition then to the degree of substitutability and the cost of transfer from one material to another, the elasticity of demand for producers' goods at any given time is affected by two variables. First, if the prices of complementary goods (i. e., labor and other materials) required along with the goods in question are constant, the price elasticity of demand for that producers' goods will be low—substantially less than that for the finished product from which it was derived. Second, since the production process is a time-consuming process (longer for capital goods than for raw materials), the elasticity of demand for producers'

goods will vary with the expectations of buyers as to the potential business situation and potential shifts in the demand for their finished product over a future which varies in length with that of the pertinent production process.

Since steel is primarily a producers' good, the price elasticity of market demand will have two functional characteristics, neither of which is given effect in Dr. Yntema's study.

(1) Price elasticity of demand for steel products is likely to vary widely with the amount of price change.

Small price changes, the only changes measured by Dr. Yntema, may have little or no effect on quantities purchased while large changes may cause substantial variations. This is perhaps an unavoidable defect of the correlation method of estimating demand elasticity from historical price series where price changes are small. It was admitted as a possible qualification to his analysis by Dr. Yntema (see "Exhibit No. 1411"). To my mind the error is graver than he appreciates. He analyzes demand as though it were a continuous function of price, that is, as though increases of demand occurred with very small changes in the price. Even if so, it is hazardous to project demand elasticity beyond the range of observed price changes. But the considerations already noted suggest that, for producers' goods, the demand is more likely to be a discontinuous function of price. This means that with a small change in price, no change takes place in quantity sold, but with a large change, you may get a substantial increase in output.

Mr. HINRICHS. What you mean there is that the increase in consumption with the 20-percent reduction in price might be more than twice as great as the increase in consumption with the 10-percent reduction. You don't mean that Dr. Yntema has omitted any observations but that the changes in the price of steel in the past have been so narrow as to restrict this study to the effect of comparatively small changes in price?

Dr. DECHAZEAU. That is perfectly right. Please bear in mind that I am not criticizing Dr. Yntema as a statistician. I have the greatest admiration for Dr. Yntema's work. What I am calling attention to are certain limitations as to the significance of the demand elasticity as determined by the correlation method. That is my only objective.

(2) Price elasticity of demand for steel products is likely to vary substantially from one stage of the business cycle to another, that is, from one level of price for complementary goods and from one level of business expectations to another.

The time of price change and the responsiveness of the price of steel to other factors in the total market situation cannot be ignored without invalidating the measure of demand elasticity derived. It seems almost self-evident that no businessman could neglect with impunity the importance of the timing of his price changes. By the same token, any average measure of demand elasticity which abstracts from it must prove an erroneous criterion of pricing policy. Such an average demand elasticity over the period 1919 to 1938 has been derived here by the correlation method, That is, actual changes in sales were correlated with actual changes in the finished composite price, and the demand curve was derived from it.

Mr. HINRICHS. May I interrupt with a second question on this subject? When you are talking about the relationship between the

changes in the price of steel and the use of steel and pointing out that steel is a producer's good, very largely, and that the change in the price of steel is only going to effect demand significantly if it is passed on in the final product, you are distinguishing, are you not, between two different points of view, with reference to which this problem of price flexibility might be approached. From the businessman's approach as to what he can reasonably expect to have happen and how he ought to behave in the face of that, insofar as he is engaged in making policy the fact that a change in the price of steel is not necessarily passed on, is a very important factor for the consideration of the United States Steel Corporation as a business enterprise.

What you are opening up in that suggestion is the further suggestion that there is a very real interest by the community at large in general matters of pricing policy, that a change in the price of steel alone would be likely to have a very insignificant effect, that changes in the price of steel plus changes in the price of other products if reduced costs of steel were fully passed on, might have a very much larger effect that has been the case in the past, when very frequently those changes in price were not passed on in a reduction in the price of finished goods.

Is that a correct interpretation of the limitation that you drew earlier in your discussion there?

Dr deCHAZEAU. That is a point which I planned to make.

Dr. HINRICHS. I'm sorry.

Dr. deCHAZEAU. You have gone a little beyond, I think, any point that I have made as yet. My main point here, if I may interpolate, is merely this: That since the demand for producers' goods is likely to vary with profit expectations, and since also insofar as steel is a raw material which may be substituted for other materials, the cost of transfer and substitutability may be involved, you might expect two conclusions; first, that the demand elasticity would be very low in the short run for a small change in price, but it might be much greater with a larger change in price; and, second, that the demand elasticity is likely to vary from one stage of the business cycle, and therefore business expectations, to another stage.

That is the only point which I am making here. if you take a single static—that is, "normal"—concept of demand elasticity throughout the entire period of 1919 to 1938, it seems to me that theoretically you must have an erroneous picture of demand with reference to potential price changes for any given state of facts, even though, as an average, it may have some meaning.

Acting Chairman KING. When your commodity perhaps may be subjected to competition from abroad, that is a factor, tangible or intangible, affecting the question of elasticity, is that not true?

Dr. deCHAZEAU. Senator, I should say it would not affect the question of elasticity but it will affect the question of what price you charge.

Acting Chairman KING. You relate elasticity to prices, don't you directly or indirectly?

Dr. deCHAZEAU. Yes; but elasticity is a measure of the variation in the proportion of steel which will be taken with a given proportionate change in its price.

Now, imports from abroad or price competition from abroad may have the effect of forcing the Steel Corporation or forcing domestic

producers to reduce their prices irrespective of the elasticity of demand.

The assumption that other things are equal, a necessary assumption for the derivation of a statistical measure of price elasticity from a time series by the correlation technique, is false and vitiates the conclusion as a measure of the effect of a price change in a dynamic situation.

When I say it is false, I mean as an actual market phenomenon, one can change that assumption but it narrows the significance of your conclusions.

As indicated a moment ago, the price elasticity of demand for a steel product is likely to vary from one state of facts to another; that is, either within the so-called business cycle or over longer periods of time. More important for pricing policy than price elasticity at any given time are shifts in the entire demand curve for the product. That such shifts may take place in the absence of price change or despite a price change for a particular product does not mean that they may be neglected in the determination of pricing policy. Dr. Yntema's analysis of price elasticity does neglect the impact of price on shifts in the demand curve.

Dr. KREPS. Would you explain more clearly what you mean by shifts in the demand curve?

Dr. DECHAZEAU. Yes; a shift in the demand curve represents an increase in the quantity that will be taken at the same price; that is, a change in the economic conditions, either by reason of a change in profit expectations or by reason of a change in the general cost picture, which will increase the demand for the product without a change in its price; whereas demand elasticity is of necessity a measure of relative changes in quantity to be taken, with relative changes in price, and therefore implicitly assumes that the conditions remain the same.

Dr. KREPS. To state what you have to say a little more clearly or fully, Dr. Yntema's analysis assumes that at a given price or for an average of prices for steel products, the same amount would be taken throughout the period which he covers, namely, 1929, 1932, 1937, and 1938?

Dr. DECHAZEAU. That is right. That is, it seems to me that in the use of the demand elasticity figure which he has developed, which is derived from the study of an historical series from 1919 to 1938, in the use of that curve, he must assume that irrespective of the changes in conditions, the actual demand change with relation to the price change would have been the same in any year.

Dr. KREPS. Do you regard that as probably true to fact, that at any given price, the same amount of steel could have been sold both in 1929, 1932, 1937, and 1938, or is that contrary to fact?

Dr. DECHAZEAU. Well, I clearly regard it as erroneous, as I have just stated.

Mr. HINRICHS. Pardon me, but did you state yourself correctly there, that the same quantity of steel would be sold at the same price in any one of these years, or did you mean to say that Dr. Yntema's analysis indicates that a 10-percent reduction from the prices which prevailed in 1932 would have tended to increase consumption in 1932 by 3 or 4 percent. That is, a reduction of 10 percent from whatever price prevailed in 1932 when they were selling four and a half million tons, would have yielded another 3 or 4 percent above the four and

a half million tons. Similarly, prices 10 percent lower than those which prevailed in 1937 would have tended to produce 10 percent greater consumption than the 13,000,000 tons that were sold in 1937? It was that 10 percent related to 3 percent that you spoke of as being constant?

Dr. deCHAZEAU. It is the elasticity relationship.

Mr. HINRICHS. Would that be constant year after year as this is presented? You didn't mean to say that at $75 a ton for a given product, the same quantity would be sold in 1932 and 1937?

Dr. deCHAZEAU. No; because obviously he points out the effect of industrial conditions upon the total demands for steel as being a very important factor.

Mr. HINRICHS. Your point is merely then that there is logical reason to believe that the effect of the 10 percent price reduction in one phase of the business cycle may be very different?

Dr. deCHAZEAU. Very different.

Mr. HINRICHS. Than the effect of a 10 percent price reduction in another phase of the business cycle?

Dr. deCHAZEAU. That is my point.

Mr. FELLER. Can your point be restated in this way, not that Dr. Yntema has overlooked the fact that there are changes in underlying business conditions, but that he has derived the theoretical measure of elasticity which can apply only if all other things are equal, and all other things are never equal?

Dr. deCHAZEAU. Yes; as I see it for the purpose of application of the correlation technique to a historical series, with the object of deriving a price elasticity of demand, you must assume that other things are equal, and he has explicitly made that assumption. I have no doubt whatsoever that Dr. Yntema would agree that conditions are not equal from one time to another.

Now, as he pointed out this morning, it was his own judgment that although secondary repercussions of price change would increase demand, such a possible shift in demand was far more than compensated by his assumption of a unitary elasticity of demand, some three times greater than the 0.3 to 0.4 elasticity which his study indicated.

Acting Chairman KING. I don't quite understand, Professor [laughter], how in this changing world, in this rather confused political and economic and industrial situation, you can predicate any view that prices will be the same tomorrow or the next day in any industry or in relation to any product. I cannot conceive of a formula that would compel or produce or result in a straight line, if I may use that expression, of prices with respect to any particular product, and if Dr. Yntema attempted to convey the idea that there was a formula under the terms of which, in this changing economic situation, there would be a constancy of prices, I did not understand it and I would not agree with him, if that was his view.

Dr. deCHAZEAU. Neither did I understand that to be his view. What he was trying to indicate was the cost situation, on the one hand, and the demand situation, on the other, which confronted the United States Steel Corporation in making a price or in determining whether a price reduction was desirable.

Acting Chairman KING. Well, the cost situation can change as well as the demand can change, can it not—if not there, at least frequently?

Dr. deCHAZEAU. It changes in a stable way, namely, that the variable cost is a constant and varies with the output.

Acting Chairman KING. Well, I wouldn't agree with that.

Dr. deCHAZEAU. I hope not. [Laughter.] That is what I have been trying to bring out.

Acting Chairman KING. Well, I am very glad that w- elicited now the proper interpretation of your observations.

Dr. deCHAZEAU. If it could be assumed that the economy was operating at, or that there was an effective tendency toward full use of resources and that prices were governed by differential costs, this atomistic approach to the problem of demand on the assumption that other things are equal would be less fallible. But the larger, in terms of employment, the industry under consideration, the more important the impact of its pricing policies on the economy, the more characteristic the adoption of prices only indirectly related to differential costs, and the more widespread is unemployment of resources, the more certain it becomes that other things are not and cannot be expected to be equal. If other things cannot be assumed equal, Dr. Yntema's analysis of price elasticity of demand cannot be considered a criterion of desirable pricing policy even for the United States Steel Corporation.

Irrespective of short-run inelasticity in demand, prices of steel products must be adapted to the long-run development of volume business by consuming industries.

In the short period it is probable that the demand for most products and especially that for producers' goods, either raw materials or capital goods, is relatively inelastic. The short-run demand for consumers' goods tends to be governed by habits of consumption. Among producers' goods, the substitution of one raw material for another is limited by technological conditions involving product design, labor skills and installed capital equipment and the demand for any given raw material is limited by the prices which must be paid for complementary goods, including labor. Substitution and the development of volume business in a steel product, therefore, is probably a function of long-run pricing policies rather than short-run and of adaptation of product to consumer needs more than either.

The automobile industry illustrates my meaning. Although at any given time in the evolution of that industry, the price elasticity of demand for steel products was probably low, the development of steel products, such as sheet and strip, which could be stamped and processed under mass production conditions, together with a downward trend in prices of these products, has undoubtedly constituted a major factor in the growth of the consuming industry and the demand for steel. Neither the ratio of steel costs to total costs in the consuming industry nor the existing price elasticity of the demand for automobiles could measure this potential demand for steel. (By way of parentheses, the ratio of steel costs to retail price of goods made from steel, as used by the Corporation, understates the importance of steel cost in finished price since it neglects all margins in distribution commonly computed on a percentage basis. This is a minor point, however, and the correction perhaps would be small.)

It was the profit potentialities in a new method of production wicth were altered by such changes. To measure the potential

demand for steel by the ratio of steel costs to total costs per unit of finished product on the assumption that all other things are equal, is to violate the dynamics of demand and to neglect the influence of altered profit possibilities on the character of the productive process and consequently on investment, employment and purchasing power.

What has probably been true of automobiles may still be true of containers, housing and other consuming industries. The only point here stressed is that the short-run price elasticity of demand for steel products, on the assumption that other things are equal, falsifies the character of the demand for steel.

Irrespective of short-run inelasticity of demand, price policies for steel products must be integrated in time with investment opportunities if a desirable volume of business is to be maintained.

The demand for capital goods, for other producers' goods, that is, raw materials, and even for durable consumers' goods varies primarily with price and income expectations of buyers. Thus the pricing of any durable goods is of the utmost importance as it may affect the timing of purchase. In an economy in which there is an effective tendency toward full use of resources, this shift in purchases over time, rather than any net increase in total demand in the long run, might be expected to exhaust the possibilities in the timing of price change. Even in this state of facts, the timing of price change would be far from an incidental phase of price policy in its tendency to correct business cycle changes and maintain volume of sales.

But in the presence of a large and possibly permanent volume of unemployment, proper price changes may not merely shift an existing demand in time, but, through their impact on investment, employment, and income in the economy as a whole, they may bring a net increase in total demand. Thus, a price policy dictated by a demonstrated short-run inelasticity of demand for steel—i. e., a high price—may defeat the interests of the industry.

Increased expenditures on steel at the higher price would limit potential expenditures in other directions. These reduced expenditures mean lower money incomes for producers of other goods, decreased profit possibilities or increased losses, and consequently increased unemployment. The effect is likely to be cumulative because, characteristically in such a state of facts, actual steel prices exceed differential costs while investment by the steel industry is likely to be curtailed. In other words, hoarding by the steel industry is more likely to increase than to decrease. The net result is a decrease in the demand for steel.

To the extent that the steel industry is a price leader for other industries, the restrictive effect on the national income is magnified and the demand for steel is further restricted, That is, if other industries follow steel prices, a rise in steel prices bringing a higher price in other industries, would have the same restrictive and cumulative effect.

Finally, as to the social problem, if Dr. Yntema's analysis of demand reflects faithfully the businessman's criterion of desirable price, he has dramatized the conflict of private and social interest in pricing policy which is the fundamental issue before the Temporary National Economic Committee.

In an economy in which there is less than full use of resources, the public interest in pricing policies centers on the impact of industrial

prices on total employment and income. After Dr. Laughlin Currie's able exposition before this committee,[1] it is not necessary for me to explain how national income is but another aspect of total expenditures, primarily by businessmen, on production and investment. But a price reduction for a given product which merely increases expenditures on that product at the expense of substitutes may have no net advantage for the economy as a whole. Indeed, unless it leads to dishoarding in the industry so benefited, it may actually decrease the total use of resources. Where there is extensive underutilization of capacity, this is the most likely result. Thus, price reductions in goods for which demand is elastic have a problematical effect on full use.

On the other hand, price reductions in commodities for which demand is relatively inelastic free purchasing power for expenditures in other directions. Unless there is a net increase in hoarding, therefore, the effect on the economy is likely to be stimulative. This is the paradox of pricing policy in an economy characterized by less than full use of resources. In those industries in which demand is elastic, private interest may dictate lower prices of problematical social value while in those industries in which demand is relatively inelastic, private interests may dictate high prices which bring upon industry and the economy the consequences it is most anxious to avoid—reduced demand, unemployment, lower income.

On the other hand, any individual firm (no matter how large) which attempted alone to implement a contrary policy would probably endanger its financial solvency. To be effective in stimulating an increase in demand (despite existing price inelasticity on the assumption that other things are equal), price changes must cut across industries and complementary goods and must be integrated with investment schedules and a monetary policy conducive to such investment. The attainment of such a coordinated program is beyond the scope of any given firm or industry, no matter how well-disposed it may be.

Wherever (for any reason) the size of the individual firm is so large as to force or induce price leadership, or the number of sellers of a relatively homogeneous commodity in a given market is so small that each determines his pricing policy with reference to the price elasticity of the market demand for the industry product rather than the cross-elasticity of the demand for his own output, this conflict between private and social interest in pricing policy is of paramount importance. To break up existing corporations by law into units sufficiently small to resolve this conflict, although in many instances the obvious procedure, would in many others be inconsistent with the trend of legal and judicial opinion over the past half century, and, in some, would be inconsistent with the economics of production and distribution. To subject such industries to direct Government control would project the economy into a maze of bureaucratic regimentation inconsistent with democratic institutions and processes of dubious merit unless a positive and integrated program of desirable behavior had been devised, and of doubtful necessity if such criteria of desirable price behavior had been defined and Government was ready to implement them with a consistent monetary and investment policy.

I urge upon this committee the necessity for a permanent Federal agency empowered to collect from basic industries necessary informa-

[1] Dr. Currie's testimony appears in Hearings, Part 9.

tion with regard to price, sales, costs, and investment which would permit it to devise criteria of desirable and possible price changes and, through other Government agencies, to coordinate such a program with public and public utility investment schedules and with central banking policy.

Acting Chairman KING. You are not intimating the structure of our political and economic system, are you?

Dr. DECHAZEAU. What do you mean by the structure of our political and economic system?

Acting Chairman KING. I think your observation might indicate that if the Government had determined to take over the control of private industry, then there would be no legal obstacle to that objective. You didn't mean to say that?

Dr. DECHAZEAU. I didn't say that.

Acting Chairman KING. You didn't mean to convey that idea?

Dr. DECHAZEAU. I didn't mean to convey that idea. I am not a lawyer and therefore I am not qualified to make any statement of that sort. What I did intimate is that the pulverization of industry, the breaking up of large corporations, might well be inconsistent with the legal policy which has been followed as indicated by statutes and as indicated also by interpretations of the court.

Dr. KREPS. In other words, if there were a large number of units in an industry, cross-elasticity of demand would be the important consideration?

Dr. DECHAZEAU. Yes; that is, as a matter of fact, the only reason why anyone could assume that private business interest, which is undoubtedly to maximize profits or, as is often unfortunately the case, to minimize losses, is consistent with social interest or with the interests of the economy as a whole. It is the impact of such self-interest which alone would lead to a maximization of output governed only by the producer's own cost situation.

This means that in fixing price or production policies, one thinks primarily in terms of what I have called the cross-elasticity of demand, the demand for the product of the individual firm on the assumption that its price is not necessarily met at the moment by its rivals. So soon as the number of sellers becomes sufficiently small that it is impossible for anyone to operate on that basis, but each must consider the impact of his price and production policies on his rivals, then he tends to determine his pricing policy with relation to a measure of the elasticity of the market demand.

Now, in a competitive industry, I have no doubt that you would find the market demand had much the same inelasticity that Dr. Yntema has found in steel. That does not affect pricing policy in such competitive industries so long as the number of sellers is so large that each one governs his price with relation to his cost.

Mr. WOODEN. Dr. deChazeau, do you mean by that that this cross-elasticity of demand is simply another name for competition, price competition?

Dr. DECHAZEAU. I think it is one of the essential conditions of price competition. I have used it merely as a shorthand in order to preclude using a long phrase each time.

Mr. WOODEN. You would think it might be said to be the equivalent of price competition cross-elasticity?

Dr. DECHAZEAU. I would say that it is the essential condition of it, and I would say that cross-elasticity of demand ceases to be important as soon as the number of sellers is sufficiently small that each one must take into consideration the action of his rivals.

Mr. WOODEN. Do you mean by that that price competition is something that, so to speak, is impracticable among heavyweights but it is all right among lightweights and middleweights, or what?

Dr. DECHAZEAU. Let me correct a possible misinterpretation. You may have price competition. What I am talking about is the assumed socially desirable effects of price competition. In fact, when you get price competition among large firms, you may well cut far below your costs with unfortunate effects both in that industry and for the economy.

I wouldn't want to discuss that at any great length at this time.

Dr. KREPS. In clearing up Mr. Wooden's question concerning full competition, isn't the demand for the product of the individual firm infinite?

Dr. DECHAZEAU. That is true on the assumption that you have complete homogeneity of product.

Dr. KREPS. In other words, business policy where the number of units are large is always based on the practical experience that by reducing prices they can get any amount of increased demand?

Dr. DECHAZEAU. For that reason it isn't necessary to reduce price because they can sell their entire output at the market price.

Dr. KREPS. That's right. Now, business policy, and meaning by business policy, policy which individual businessmen must follow in an industry where the number of sellers is small, has to assume that demand is inelastic. Is that correct?

Dr. DECHAZEAU. Not to assume it; it has to measure market demand rather than the demand for the product of the individual firm, and it finds, as Dr. Yntema indicates, that that demand tends to be relatively inelastic. I have no reason to doubt that that relative inelasticity (i. e., the price elasticity of the demand on the assumption that other things are equal) is probably correct. I do not consider it to be of fundamental significance.

Dr. KREPS. Let us try to rise by gradual stages from considerations of business policy to considerations that must be taken account of by the T. N. E. C. Is it true that there are a number of practices which are on the whole good business policy that may be deleterious for the industry as a whole?

Dr. DECHAZEAU. You are asking a very broad question. I have no doubt but that there are, but I am not willing to specify at this time. What I was indicating at this time was that, insofar as price policy might be conditioned on this short-run price elasticity of the demand on the assumption that other things are equal, it would be deleterious from the point of view of social policy and that it might well be deleterious for the industry as a whole, even though no single firm in the industry could operate on any other assumption without endangering its solvency. That is, as I see it, the dilemma, that is the paradox, that is the problem. In order to make a price reduction effective in bringing about a significant shift in demand, it is necessary that it must cut across industry and probably cut across complementary goods. If you assume that the prices of all other com-

plementary goods remain the same, then a price reduction in the short-run can bring very little shift, I should think. I should agree with Dr. Yntema, on that assumption.

Dr. KREPS. Is industrial policy always consistent with economic policy? That is, is it true that what is good for the industry as opposed to what is good for the individual business, is always good for the economy? For instance, you indicated here that when industry becomes organized into few units it has almost an inherent interest in higher prices.

Dr. DECHAZEAU. I should say that industrial policy may be opposed to the general economic interest insofar as each member of the industry is interested in maintaining his position and precluding or minimizing losses. From the point of view of the economy as a whole, the bankruptcy of a firm is a matter of no importance. It may be the step by which one gets greater efficiency and greater progress.

Dr. KREPS. In an economic policy which endeavors to maintain competition, we have a profit and loss economy. Is that correct?

Dr. DECHAZEAU. Yes; at all times.

Dr. KREPS. At all times. Therefore it is not necessary that each firm in an industry, in fact it is almost the surest sign of lack of health if each firm in an industry makes a profit. The normal situation is that some firms make extraordinary profits, a large run of firms make ordinary profits, and then there is a marginal firm, and then is it not true (studies of the Tariff Commission have indicated such) there is a group of "lunatic fringe" firms with bad luck or bad management or what have you that are in process of elimination.

Dr. DECHAZEAU. That is right, and that is likely to be characteristic at all stages of the cycle.

Dr. KREPS. So that the problem that the committee has to consider and has to decide before it accepts whatever is valid for the business of an individual firm as being valid for the economy as a whole is whether or not this particular Corporation is, let us say, a marginal firm or one even less efficient than the marginal firm? That is one of the problems, at any rate, that the committee would have to consider. Is that correct?

Dr. DECHAZEAU. That would be correct, particularly if one were talking about the level of costs rather than the behavior of costs. I have concerned myself with the behavior of costs rather than the level of costs, and have not raised the problem as to whether the level of costs as indicated in the Corporation's study is in any sense characteristic of the industry and therefore whether the Steel Corporation may not be a so-called extra-marginal firm whose efficiency is reduced by reason of its size.

Dr. KREPS. One further question. Economic policy in turn has to be integrated with what we may call public policy. Man doesn't live by bread alone; economic aspects aren't the only aspects that are important. Sometimes public policy as expressed, for example, in the tariff, obviously departs from sound economic policy in order to give the favor and the cloak of government to special interests. Sometimes we disregard economic policy in order to effect a policy of national isolation, self-sufficiency, or of defense. Is that true?

Dr. DECHAZEAU. I should agree with that.

Dr. KREPS. And would you agree that the province of the Temporary National Economic Committee is the province of economic policy and of public policy as well as industrial policy and business policy?

Acting Chairman KING. I was about to say that I think the statute under which we are operating determines what our province is.

Dr. DECHAZEAU. In answering the question directed to me, my own feeling would be that obviously the committee is concerned with what is desirable policy from the point of view of society as a whole, as public policy and good economic policy, and whether the particular industries investigated, in determining their own policies, determine them in a way consistent with the attainment of the objectives of social policy.

Acting Chairman KING. I presume we may proceed upon the theory that in weighing these various questions that are brought before us we weigh them in the light of the fact that we are a republic, we have a constitutional form of Government, and this is a democracy and not a Hitler form of government, or one approximating the totalitarian attitude of governments throughout the various parts of the world. Isn't that right?

Dr. DECHAZEAU. Yes; and that is why, Senator, in making the last point I want to emphasize that it doesn't seem to me that the alternative for this committee is to accept business policy as it has historically developed as inevitable, on the one hand, or, on the other hand, to regulate that industry. It seems to me that what is necessary is primarily some form of agency, Federal agency, empowered to collect from basic industries necessary information with regard to actual prices, sales, costs and investment which might permit the analysis of what is desirable price policy from the point of view of society, and that might also be in a position to operate through other Government agencies to coordinate that program with public expenditures; with public utility investment schedules primarily—I am merely indicating places where this is possible through existing controls—and with a central banking policy. Frankly, I consider it rather futile to criticize private business corporations for their pricing policies in terms of results before any criterion has been developed as to what is desirable.

Mr. BALLINGER. Could such a criterion be developed, in your opinion? I mean, assuming we had all this information, could you then sit down and tell the Government what would be a fair price in steel?

Dr. DECHAZEAU. I shouldn't presume to answer that in the affirmative. I would say this, that if such a criterion cannot be developed, then we are at a most unfortunate impasse; because if you have Government operation of industry, you must have such criteria of desirable pricing policy, and if you have regulation of industry, you must have such criteria, and, therefore, in dealing with private industry, before you can criticize it for its actual pricing policy, you must have developed some criterion which is known.

Mr. BALLINGER. Assuming that we concede your point, that competition is impossible in the steel industry, that is, if it were possible——

Dr. DECHAZEAU (interposing). I didn't make that point, but, if you wish to assume it, you may.

Mr. BALLINGER. Well, for the sake of argument they have reached a point where they couldn't afford to compete. Do you think reduction in the number of steel concerns in the United States has been entirely in the public interest? Will you agree with me that these concerns have grown largely by the processes of merger and combination and acquisition of competitors' assets, I mean by artificial processes?

Dr. deChazeau. You want my opinion and my judgment, I assume. My judgment in the situation is that they clearly have not been in the public interest.

Mr. Ballinger. You think a smaller size would have been better?

Dr. deChazeau. Well, if you pin me down to what constitutes a smaller size, I cannot answer for lack of knowledge of the magnitude of economies of integration and mass production within the industry. That requires, at least as a starting point, some sort of cost analysis of the industry.

Mr. Ballinger. We couldn't say definitely, or you wouldn't be willing to say definitely that we can produce steel cheaper under these giant concerns which have been created by artificial processes than might have been produced under concerns that were less integrated and perhaps subjected to the competitive system. We don't know about that, do we?

Dr. deChazeau. No.

Mr. Ballinger. We have always proceeded on the assumption that whatever size it arrived at, by whatever method it got there, it is good and in accordance have so protected it, without analyzing the question of whether they are or not efficient, whether they result in lower costs or not. I am pointing that out because that is the trend as I have seen it.

Dr. deChazeau. That is right.

Acting Chairman King. You don't want us to deduce a conclusion from your views that this committee is to consider the propriety of destroying any branch of the capitalistic system and turning it over to public ownership and public control?

Dr. deChazeau. Well, if I may repeat my statement, Senator, since it seems to have been lost somewhere, I emphasize that to subject such industries, industries in which competition does not work purely and perfectly——

Acting Chairman King (interposing). I could assume that there are industries in which competition does not exist or in which competition in a reasonably short length of time would result in competition, even though temporarily there might be an arrested process of competition.

Dr. deChazeau. There are all sorts and varieties of competition. What I am assuming is that there are industries in which the size of the individual firms with relation to their market is so large that the policies of the individual units within that industry are not conditioned on their own cost situation with relation to the market price, but are conditioned on the reaction of their rivals to a price or production policy or investment policy determined by them. In the determination of that policy, taking into consideration this impact of rival policies, you do not attain the same type of price competition that you would have in other industries; and that price competition which you do attain in such industries is not likely to give you prices which are related to or determined by differential costs.

Dr. Kreps. Let me turn back to the analysis. Under a situation in which there were a large number of firms, would any analysis of market demand be legitimate which neglected cross-elasticity?

Dr. deChazeau. Analysis of market demand in such a situation would have no significance so far as the individual unit was concerned.

Dr. Kreps. In other words, if there were competition, full compe-

tition, the individual business in an industry could proceed on the assumption that the elasticity of demand for its particular product was infinite.

Dr. deChazeau. That would be the assumption.

Dr. Kreps. The less the competition the more the elasticity of demand diminishes from infinity down to 10, 5, and 0.3. Correct?

Dr. deChazeau. No; wait a moment. You are now talking about the market demand elasticity.

Dr. Kreps. Yes.

Dr. deChazeau. It seems to me that the market demand price elasticity might be quite inelastic, much less than unity, and still the individual units within the industry might operate, would operate, on the assumption that the demand for their product was of infinite elasticity.

Dr. Kreps. That is the point I wanted to make. In other words, it would be unimportant to the individual enterprise that the elasticity of demand was for the product as a whole.

Dr. deChazeau. I should say that it is of no importance to the individual farmer what the price elasticity in the demand for wheat is. It becomes important only when you set up a triple A which is trying to restrict output within the industry.

Dr. Kreps. Precisely.

Dr. deChazeau. It is beyond the power of any individual farmer to affect that market price by whatever he might decide to do. Hence he can operate on the assumption that the market demand for his product is infinitely elastic even though the market demand for the product may be very inelastic and in the short run is likely to be.

Acting Chairman King. Generally speaking, prices have gone down during the past 25, 30, 40, or 50 years, in steel and automobiles, in wagons?

Dr. deChazeau. Yes.

Mr. Ballinger. Not in steel.

Acting Chairman King. In automobiles and most of the major portion of the commodities that enter into our personal, family, and economic life. There has been a gradual reduction, has there not?

Dr. deChazeau. That is my impression, Senator.

Dr. Kreps. Although from studies of Dr. Frederick C. Mills and others who have analyzed recent price history, is it not true that the price of steel and certain other durable goods in the United States, and by exception since 1929, have stayed relatively high? As Mills points out, that is an experience quite unique in our history. It is also an experience which is not known, for example, in Japan. The relatively high price for building materials, for steel and for producers' goods in general during the thirties tended to restrict the amount of such products that can be bought and the amount of investment that is made by the economy in general, did they not?

You are familiar, I take it, with Professor Mills' analysis comprising three volumes, which tended to demonstrate that point?

Dr. deChazeau. In a general way, yes; but I wonder if we do not get beyond the discussion of price elasticity when we talk about price trends?

Dr. Kreps. Quite. It is only apropos of the problem that high or low prices have no meaning unless set in terms of other prices?

Dr. deChazeau. That is right.

Dr. KREPS. And relative to agricultural prices and food prices and other items, the prices of steel and of steel products are still relatively high, even though there has been an absolute decrease since 1921?

Dr. DECHAZEAU. Yes; I should agree that a downward trend in a price is to be measured with relation to the prices of other products, and I should agree likewise with the point which Dr. Yntema made this morning, that price flexibility is most meaningful with relation to cost flexibility. That is why it seems to me that the cost analysis is so crucial to this entire discussion.

Acting Chairman KING. Does that finish your statement?

Dr. DECHAZEAU. Yes, sir.

Dr. KREPS. I had intended to call Dr. Yntema back to the stand, but in view of the lateness of the hour, I should like to call Dr. Yntema and the assistants who helped him, tomorrow. I suggest Dr. de-Chazeau be recalled to the stand tomorrow.

IN MEMORIAM SENATOR WILLIAM E. BORAH

Acting Chairman KING. This is deserving of consideration. When we met yesterday we were advised by the chairman of the committee of the passing of one of the members of this committee, and a committee was named by the chairman to prepare appropriate resolutions to offer, to be incorporated in our record. The committee has acted and I am authorized as chairman of the committee to submit the following for the committee, and ask that it be inserted in the record:

In the death of Senator William E. Borah the Temporary National Economic Committee has lost a quality of service of the highest order. His judgment on the national economic problems with which the committee had to deal was broadened by a lifetime of distinguished public service from which he had emerged as one of the greatest and most consistent champions of free and independent business enterprise.

His gift of public advocacy gave him great power in advancing the cause of economic freedom. Public faith in his courage and integrity was so strong that his presence on this committee became a guaranty of the honesty of its proceedings and the good faith of its conclusions.

Yet in our sorrow over his death this committee consoles itself with the thought that it has not entirely lost his judgment or his power of advocacy, or the influence of his great prestige, because during the year and a half that he served with us he left the imprint of his views and his example on every member in a way which we cannot forget: Therefore be it

Resolved by the Temporary National Economic Committee in meeting assembled, That this committee spread upon its records the acknowledgment of its indebtedness to Senator Borah; that we constantly keep in mind during our future deliberations and hearings his counsel and example, and that in that way we guard and preserve the great contribution which he has already made to our work.

We will adjourn until 10:30 tomorrow morning.

(Thereupon, at 4:50 p. m., the committee recessed until Wednesday, January 24, 1930, at 10:30 a. m.)

INVESTIGATION OF CONCENTRATION OF ECONOMIC POWER

WEDNESDAY, JANUARY 24, 1940

UNITED STATES SENATE,
TEMPORARY NATIONAL ECONOMIC COMMITTEE,
Washington, D. C.

The committee met at 10:40 a. m., pursuant to adjournment on Tuesday, January 23, 1940, in the Caucus Room, Senate Office Building, Joseph J. O'Connell, Jr., special assistant to the General Counsel, Treasury Department, presiding.

Present: Mr. O'Connell (acting chairman), Senator King, Representative Williams, Messrs. Lubin and Hinrichs.

Present also: Hugh White and Walter B. Wooden, representing the Federal Trade Commission; John V. W. Reynders and Walter White, representing the Department of Commerce; William W. Werntz, representing the Securities and Exchange Commission; A. H. Feller representing the Department of Justice.

Acting Chairman O'CONNELL. The committee will be in order.

Dr. Kreps.

Dr. KREPS. In each case, the testimony of the group that has been incorporated under the Temporary National Economic Committee has been given to Dr. Yntema and other members of the staff of the Steel Corporation so that they might make their comments.

I want to say that all of us are anxious to avoid undue and sterile debate. All of us are equally anxious that the points of difference in the debatable area are clearly stated. I have asked Dr. Yntema to make his comments upon Dr. deChazeau's remarks. I believe he would like to have two of his assistants sworn in by the committee. Is that correct, Dr. Yntema?

Dr. YNTEMA. Yes; I should appreciate that very much, Dr. Kreps. Mr. Appert was primarily responsible for the study of the costs and relation of cost to volume, and Mr. Lewis undertook the statistical analysis of the demand for steel. I shall appreciate it if you will call them at this time.

Dr. KREPS. I would like to call Mr. Appert and Mr. Lewis to the stand.

Acting Chairman O'CONNELL. Will you each raise your right hand, please? Do you and each of you solemnly swear that the testimony you are about to give in this proceeding will be the truth, the whole truth and nothing but the truth, so help you God?

Mr. APPERT. I do.

Mr. LEWIS. I do.

TESTIMONY OF HAROLD GREGG LEWIS, INSTRUCTOR IN ECONOMICS, UNIVERSITY OF CHICAGO, AND RICHARD H. APPERT, ATTORNEY AT LAW, RUTHERFORD, N. J.

Dr. KREPS. Mr. Lewis, for the purposes of the record, will you state your full name?

Mr. LEWIS. My name is Harold Gregg Lewis.

Dr. KREPS. Address?

Mr. LEWIS. 1535 East Sixtieth Street, Chicago.

Dr. KREPS. You are instructor in economics at the University of Chicago?

Mr. LEWIS. That is right.

Dr. KREPS. You are also research associate of the Cowles Commission for Economic Research at the University of Chicago?

Mr. LEWIS. Yes.

Dr. KREPS. And you are the author of two of the exhibits which have been submitted here, "Exhibit No. 1411," [1] entitled "A Statistical Analysis of the Demand for Steel, 1919–38," and "Exhibit No 1412," [2] entitled "An Analysis of Changes in the Demand for Steel and in Steel Prices, 1936–39"? Is that correct?

Mr. LEWIS. That is correct.

Dr. KREPS. For the purposes of the record, Mr. Appert, will you state your full name, please?

Mr. APPERT. My name is Richard H. Appert.

Dr. KREPS. And your address at present?

Mr. APPERT. My address is 62 Ettrick Terrace, Rutherford, N. J.

Dr. KREPS. What position do you hold?

Mr. APPERT. At the present time I am a lawyer with Mr. Olds' firm.[3]

Dr. KREPS. I understand that you were formerly instructor in accounting at Fordham University.

Mr. APPERT. That is correct.

Dr. KREPS. And you have assisted particularly in the study of the relation of volume to cost?

Mr. APPERT. That is correct. I have done the work under Dr. Yntema's direction and with the assistance of other members of our group.

Dr. KREPS. Dr. Yntema.

TESTIMONY OF PROF. THEODORE OTTE YNTEMA, SCHOOL OF BUSINESS, UNIVERSITY OF CHICAGO, CHICAGO, ILL.—Resumed

DISCUSSION OF UNITED STATES STEEL CORPORATION STUDIES

Dr. YNTEMA. We are glad to have the criticisms of our studies offered by Dr. deChazeau in his testimony yesterday afternoon, and we appreciate particularly the courtesy extended to us by Dr. Kreps and by the committee in affording us the opportunity to comment on the issues he has raised. While many points were mentioned in the discussion yesterday afternoon, it is not possible without encroaching unreasonably upon the time of the committee to deal with all of them.

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[1] Appendix, p. 13913.
[2] Appendix, p. 13942.
[3] Irving S. Olds, partner, White & Case; also a director of United States Steel Corporation.

I shall, therefore, restrict my remarks to those which I regard as most important.

First of all, I should like to clear up any misunderstanding which may exist as to the purposes for which these studies were prepared. They were not made with any idea of providing the United States Steel Corporation or the steel industry with a formula which could be used as a basis for price policy. As a matter of fact, steel men were well aware of the characteristics of the demand for steel and the behavior of costs long before we began this study. We have merely applied the methods of statistical and economic analysis to the facts and presented our findings to the committee in the simplest way we could.

Our objectives in the analysis of demand and cost were these: First, to ascertain approximately how the quantity of steel sold by the industry responded to changes in price, and second, to discover how costs varied with output from the data which were available to us.

We have presented these findings to the committee in the hope that they may throw some light on the possibilities, and on the limitations, of increasing steel consumption by reducing price and on the extent to which such price reductions could be borne by a company such as the United States Steel Corporation.

Near the conclusion of his testimony, Dr. deChazeau said that if our "analysis of demand reflects faithfully the businessman's criterion of desirable price, he has dramatized the conflict of private and social interest in pricing policy which is the fundamental issue before the Temporary Economic Committee."

In the first place, there was never any suggestion on our part that our analysis reflected or had anything to do with the businessman's criterion of desirable price.

In the second place, and more important, the phrase, "conflict of private and social interest in pricing policy" requires further clarification.

In an economic system of private enterprise, each business seeks and ought to seek to make the largest possible profit in the long run. I suppose that most businessmen would like to get a higher price for their products than they do, and I think it is correct to say that it would not be in the general social interest for them to obtain as high a price as they would like to get.

If this is merely what is meant by the conflict of private and social interest in pricing policy, it is an empty phrase. The real question is whether the price level in the particular industry is such as to warrant concern for the social interest.

There seemed to be some question yesterday as to why the steel industry did not charge higher prices for their products if they could, thereby, so obviously reduce their losses and increase their profits. Certainly it is not because the steel companies do not want to raise their profits from the levels which have prevailed over the past 10 years. The situation can only be explained by the fact that the forces of competition are great enough to keep individual companies from raising their prices.

Dr. Kreps. Would you care to elaborate that point a moment? Isn't it generally true that monopoly defeats itself, that by stimulating, as Mr. Chamberlin has pointed out in his well-known treatise on

monopolistic competition, by stimulating excessive capacity, by causing other costs, particularly selling costs, to enter into the picture the net results for the industry may none the less be disappointing even though the factor of monopolistic competition operates virtually unimpeded?

Dr. YNTEMA. I think you have made a correct statement of the theory and the fact with respect to the sort of situation you describe. Frankly, I don't think that is the explanation of why steel prices are no higher than they are.

Dr. KREPS. Although that is the only possible assumption which could have justified you in your analysis to neglect the cross-elasticity of demand because otherwise your whole analysis of demand would have no meaning for the Corporation. In a purely competitive situation the individual producer knows that he can sell his whole product at the market price, in other words the demand for his individual product in a purely competitive situation is infinite. Thus the farmer sells all of his output at the going market price.

Dr. YNTEMA. Dr. Kreps, I think you impute to us objectives which we did not have.

Dr. KREPS. Not objectives; I am asking you whether that is not the assumption underlying your analysis. I must admit, in fact I must pay tribute to the candor with which you have made that assumption. It is one of the many things I admire in your study, that you based it on the premises of monopoly and monopolistic competition.

Dr. YNTEMA. The point I would like to make is this, that we were not preparing a study to be used as a pricing policy by the steel corporation or by the steel industry. We did, however, prepare the study in the hope that this committee might be able to use this material in appraising the level of prices in the industry over the past 10 years and to date with respect to the possibility of further reductions and the results of such reductions in prices upon the industry.

We never undertook to deal with the problem of the demand for the steel sold by an individual concern. If I may go on—I expected to comment on that point.

There seemed to be some confusion yesterday between the elasticity of demand for the industry and the elasticity of demand for the individual concern. I should like to make it entirely clear that our estimates referred only to the elasticity of demand for the industry, that is, to the relation between the total quantity sold by the industry and the price of steel, and that we never at any time attempted to estimate the so-called cross-elasticity of demand, that is the demand for the steel sold by the individual firm. That is not relevant to the purposes which we had in mind.

Dr. KREPS. Mr. deChazeau, would you like to comment on that?

Dr. DECHAZEAU. Merely at this time to make the point clear that I indicated in my discussion, that Dr. Yntema had neglected that and that in my judgment he had rightfully neglected it in view of the pricing situation in the industry.

Dr. YNTEMA. At this time I should like to comment on a few of the points in Dr. deChazeau's [illegible]

of the demand for steel [illegible]

Dr. deChazeau said:

The assumption that other things are equal, a necessary condition for the derivation of a statistical measure of price elasticity from a time series by the correlation technic, is false and vitiates the conclusions as a measure of the effect of price change in a dynamic situation.

Frankly, I think that statement could only have been made on the basis of a misunderstanding of our study. We did not assume other things were equal. Our statistical analysis made allowance for the effect of other factors and yielded an estimate of elasticity of demand which would have been the elasticity upon the assumption that other factors did not vary, but it is not a measure derived neglecting the effect of other factors. We took specifically into account the effects of these other factors and adjusted for them.

(Senator King assumed the chair.)

Dr. KREPS. Let me clarify this point. Your contention is not that you neglected the other factors, but that you assumed them to be constant?

Dr. YNTEMA. No; that is incorrect. We did not assume them to be constant. We corrected automatically in the study, by the methods we used. We corrected for the effects of the other causes and the result, the measure of responsiveness of quantity of steel sold to the price, represents an estimate of what would happen if these other factors should stay constant.

Dr. KREPS. Yes; if they should stay constant.

Dr. YNTEMA. Yes.

Dr. KREPS. Which is exactly what we had in mind. I was going to ask you otherwise whether you had, and if so, whether I had overlooked finding the correction which you had made for the fact that depression is primarily a heavy industry phenomenon. The steel industry is the major industry. Therefore, the impact of unemployment or of restriction of production or of prices in steel upon general business activity is highly substantial.

I was going to ask you whether or not you had made any correction. The answer is, I take it, that your analysis proceeds on the assumption that those other factors were constant. As you just phrased it a moment ago, you proceeded as if these other factors were constant.

Dr. YNTEMA. No; I think we are now quibbling about language, and I think we understand each other. I should not state our findings in the words which you used, but I really don't think that we would gain anything in further discussion as to the terms which we employ.

Dr. DECHAZEAU. May I make a statement?

Acting Chairman KING. When doctors disagree, the patient suffers. [Laughter.]

Dr. DECHAZEAU. I doubt whether there is a real disagreement, and I offer this merely to check with Dr. Yntema. As I understand it, in the method of correlation employed or applied, you take into account the effect through the concomitant variation process of factors including price and including business profits and including changes in the industrial situation, and then in order to get at the price elasticity of demand, you eliminate those changes which are due to those other factors.

Dr. YNTEMA. That is correct.

Dr. DECHAZEAU. Isn't that correct?

Dr. YNTEMA. Yes; that is correct.

Dr. DECHAZEAU. That is what I mean by making the statement that you assume other things are equal in your final price elasticity of demand. You have eliminated the other factors from the variation in sales.

Acting Chairman KING. Doctor, are you a sufficient pragmatist and realist to understand that at the end of the month or the end of a period, a business organization, whether it has a number of activities or is limited to one, makes its findings and discovers that it is in the red or it made a profit. You admit that this is ordinarily the practical way of conducting business?

Dr. YNTEMA. That is, of course, the fact.

Dr. KREPS. We all know that.

Acting Chairman KING. Do these technical discussions which you and Dr. deChazeau and Dr. Kreps have been indulging in throw any light upon whether or not the steel industry or any industry for that matter, at the end of the term, had a deficit or had a profit?

Dr. YNTEMA. I think they throw a great deal of light upon what the deficit or profit would have been, if the price level of steel had been different.

Acting Chairman KING. Well, then, you can conceive of a hundred different reasons which would have added to the profit or added to the deficit?

Dr. YNTEMA. That is correct.

Acting Chairman KING. Such as the level of wages, the prices of raw materials, cost of transportation, and many, many other factors that enter into the conduct of a business?

Dr. YNTEMA. That is absolutely correct. We assumed, however, that the committee was much interested in the relation of the price of steel to the burden which reduction of price would have upon the industry, and some of our remarks were addressed to that point.

Acting Chairman KING. Well, the professors may continue.

Dr. YNTEMA. Dr. deChazeau said:

> As a criterion of pricing policy for the steel industry itself, the price elasticity of demand measured by Dr. Yntema is inadequate.

I should merely like to point out that we never submitted our study as a criterion of policy for the industry. I do not think it is possible for the steel industry to have a pricing policy. There was discussion with reference to whether the elasticity of demand for steel was the same in depression periods and periods of prosperity. We simply do not know from the examination of the data and we have not been able to find out. We did not assume that it was necessarily constant. Our result merely gives an average estimate of the elasticity, and we should welcome any further light which can be thrown upon that.

Again, Dr. deChazeau said:

> If other things cannot be assumed equal, Dr. Yntema's analysis of price elasticity of demand cannot be considered a criterion of desirable pricing policy even for the United States Steel Corporation.

With that I should agree, but I should point out that we never thought that it should be regarded a criterion of desirable pricing policy by the United States Steel Corporation.

Again, he said:

Irrespective of the short-run inelasticity in demand, the prices of steel products must be adapted to the long-run development of volume of business by consuming industries.

We addressed our remarks and our studies primarily to the possibility of cyclical fluctuations in steel prices, and for that purpose, the study or the consideration of short-run substitution over the period of this cycle was relevant to our analysis.

Dr. KREPS. Shouldn't you rather have used quarterly or monthly data in that event?

Dr. YNTEMA. There was a good reason for not employing quarterly or monthly data. If such data were employed, it would be necessary to bring into the study the effect not only of the level of steel prices upon the consumption of steel, but also the effect of reductions. We have found in our study that the effect of a reduction in steel price is to scare off purchasers. As a matter of fact, if the price is reduced the immediate result of that generally is to reduce and not to increase the purchase of steel.

That is not invariably so, but generally that is the effect, and we wanted to abstract that and leave it out of the picture. We preferred to take not a month-to-month effect, but to take the effects over a year-to-year period, which I think is more appropriate for this particular problem.

Dr. KREPS. It may be appropriate for a trend problem, if the period is sufficiently long but practically never utilized, is it, for measurements embracing but one major cycle?

Dr. YNTEMA. I think it is in this case the better procedure to adopt, but I do not wish to argue the point with you.

Dr. KREPS. At any rate it is contrary to accepted statistical procedure, isn't it?

RELATIONSHIP BETWEEN PRICES, DEMAND, AND COSTS

Mr. WOODEN. Dr. Yntema, I understand you to take the view that the demand for steel has only a minor effect upon the price, or rather, the price has only a minor effect upon the demand?

Dr. YNTEMA. I think we ought to clarify that statement. Let me put it this way: I should say that changes in the price level have been less important, and, within any conceivable range, will be less important in determining the quantity of steel that is sold, than other influences, such as profits, and the degree of activity in other parts of our economic system.

Mr. WOODEN. Well, do you think that the demand for steel would be affected in any substantial degree by an increase in price?

Dr. YNTEMA. You mean the quantity of steel bought?

Mr. WOODEN. Yes.

Dr. YNTEMA. I think it would be affected to some extent.

Mr. WOODEN. Only to a minor extent?

Dr. YNTEMA. It depends upon what you mean by those terms. Let's put it this way, that it would be affected less proportionately than the increase in price, and the effect upon the consumption would probably be less over a period of years than the effects of many other factors associated with the cyclical ups and downs in general business.

Dr. KREPS. I must confess that I am not clear on that point. Suppose the price of steel were raised 10 percent. Is it your assumption that the amount of steel sold would not diminish by any more than 3 or 4 percent? Is that correct?

Dr. YNTEMA. But that is a rough estimate. We pointed out——

Dr. KREPS (interposing). That is your estimate of the elasticity of your demand curve?

Dr. YNTEMA. Let me say that we took that as the best guess we could make. It may be lower than that. Many of us who studied the figures think that the elasticity is less, that by a 10 percent decrease in price you wouldn't get even 3 or 4 percent increase in volume. Some of those with whom I talked think you wouldn't get any increase.

Dr. KREPS. That is the best guess you could make?

Dr. YNTEMA. That is the best guess, with the evidence we have.

Dr. KREPS. Quite. Now, let's raise the price 20 percent. Do you mean then that the amount of steel purchased would decrease by only 6 or 8 percent?

Dr. YNTEMA. You are getting near the limit of the range of experience now.

Dr. KREPS. But not beyond the limit of the charts which you submitted yesterday for the record.

Dr. YNTEMA. I think that our discussion yesterday had to do with price changes of 10 percent generally. There was one case, however, in the discussion of the price decrease which would be necessary to bring the 1938 production up to the 1937 level where we talked about a larger change than that. Frankly, the particular results there, the particular quantities, are not very significant.

Dr. KREPS. I am referring to Chart B-5 of "Exhibit No. 1409," [1] in which you give in rather precise terms the total loss, as well as estimated additions to deficit if prices had been reduced as indicated.

Dr. YNTEMA. Yes; that ranges up to 18 percent, which is within the range of experience on which our studies are based.

Dr. KREPS. Would you go on and say that if prices were increased 30 percent the amount of decrease in steel demand would be only 9 or 12 percent?

Dr. YNTEMA. If I may, I should like to be excused from answering that question. I think it is in a realm not important for business policy. I don't know and I don't think anyone knows.

Dr. KREPS. Isn't that the kind of price change that has occurred in the industry according to your own figures, and therefore the kind which may be vital for the purposes of the committee?

Dr. YNTEMA. I should say that if you are going to effect any great increase in quantity of steel sold you would have to talk about changes of that order of magnitude, and I think that if you are going to consider those you must immediately consider the impact upon the losses in the industry. And those losses would be so great that the steel companies in the industry would almost immediately go into bankruptcy unless they could pass on the reduction in prices to the wage earners and to the others from whom they buy materials.

Dr. KREPS. In other words, steel prices you feel are based on costs. Is that correct?

[1] Appendix, p. 13781.

Dr. YNTEMA. I would never make the statement in quite that form. I should say that cost is one factor which enters into price, and it is a very important factor, and the relevance of cost to price depends upon how long a period you have in mind. Prices might be considerably less than cost in the short run. In the long run they will tend to be approximately of the same order of magnitude.

Dr. KREPS. You will remember that yesterday you submitted a chart of indexes of costs, actual costs, and of mill-net realizations. As I understand it, mill-net realization reflects pretty well what the consumer pays to the industry. At least that is in substance your contention. Is that correct?

Dr. YNTEMA. I think that is a fair statement.

Mr. REYNDERS. Isn't it correct to say that the costs are a deterrent against going indefinitely below in the price range?

Dr. YNTEMA. I'm sorry; I didn't hear the question.

Mr. REYNDERS. Is it not correct to say that the costs form a deterrent against undue reduction of price; that is, when you get below your cost line you know you are in a danger zone and you begin to hesitate?

Dr. YNTEMA. That is correct; yes. The function of costs in the processes which establish prices is to set a downward limit. Ordinarily a businessman will not undertake a venture which will bring him in a smaller income than the additional costs resulting from that venture. That is simply plain common sense and good economic theory. The costs set a downward limit with respect to prices.

Mr. REYNDERS. And when you reach that cost line any disposition to take business below that cost line will be actuated by your desire to maintain your position in the industry or to meet some competition from a competitor, which may be wise or unwise?

Dr. YNTEMA. Yes. You and I probably would use slightly different words in saying the same thing, but I should accept that.

Dr. KREPS. Turning now to chart C–25 of "Exhibit No. 1409"[1] which is on the easel, the lower line representing prices to the consumer substantially——

Dr. YNTEMA (interposing). May I interrupt? The lower line represents an index of mill-net yield. That does not represent the absolute amount of prices.

Dr. KREPS. Yes; but it does mean that when the index reaches a low of somewhere around 75 in the middle of 1933, the actual price to the consumer was probably somewhere in the vicinity of 25 percent less than it was in 1926.

Dr. YNTEMA. Yes; that is correct.

Dr. KREPS. Now the actual costs, on the other hand, also are indices, are they not?

Dr. YNTEMA. Yes; the top is an index of the average cost per weighted ton shipped.

Dr. KREPS. Therefore, irrespective of whether these are absolute amounts or indexes, the relationship shown by your chart is the relationship between prices to the consumer and costs to the Steel Corporation.

Dr. YNTEMA. Well, if I were to say that I would qualify those terms. I should say that the chart shows the relative movement of

[1] Appendix, p. 13835.

the prices to the consumers, and the average cost to the Steel Corporation.

Dr. KREPS. The relationship, if you will observe, between costs and prices, therefore, is, if anything, inverse; the higher the actual costs go, the less the Corporation tends, historically speaking, to receive from the consumer, as you brought out yesterday.

Dr. YNTEMA. That is correct in respect to these particular average costs.

Dr. KREPS. They sell a smaller volume and are doubly hurt because they also sell it at a lower price at the precise time when their actual cost per unit is higher than it has been before.

Dr. YNTEMA. It is the actual average cost. If you look at the other line you will see that the cost prices which they are paying for goods and services do tend to vary in the same direction.

Dr. KREPS. But these deficits that you have estimated are on the basis, are they not, of total costs at each level of output? If you take the total costs and divide by total output, you get average cost, which is represented by the upper line and therefore the line that is pertinent to the problem of whether there were losses and pertinent to the problem of whether or not pricing policy was actually based on the behavior of costs.

Dr. YNTEMA. No; I don't want to be quoted as saying that in the short run over the cycle that average costs determine what the price will be. That we all know is not correct, and this chart demonstrates beyond any possible doubt that that is not what did happen.

Dr. KREPS. I want to make clear for the committee one other problem. I would like to have chart B-1 of "Exhibit No. 1409" [1] again put on the easel, please. When you speak of cost of steel you don't mean steel, do you?

Dr. YNTEMA. That depends upon which particular statement of mine you are referring to.

Dr. KREPS. This cost that you have here measured, "Relationship between total costs of operations and volume of business," does not represent a particular steel product?

Dr. YNTEMA. That does not represent a particular steel product. We took some pains to point out that those costs are the total costs of the Steel Corporation excluding certain miscellaneous, extraneous operations. Those costs therefore extend beyond the production of steel. Just very roughly, I should say that 90 percent of those costs represent the costs of steel operations.

Dr. KREPS. Your figure was 89 percent.

Dr. YNTEMA. I say roughly 90 percent.

Dr. KREPS. What is the rest of it?

Dr. YNTEMA. The rest of it represents the cost of producing other byproducts of the steel industry, the cost of producing cement, the cost of furnishing various transportation services to outside——

Dr. KREPS (interposing). Of the steel products that you have, how many would you estimate are roughly included?

Dr. YNTEMA. Well, I never undertook to count the number of steel products.

Dr. KREPS. But it is many thousand?

Dr. YNTEMA. It is undoubtedly many thousand; it depends on how you define a product, however.

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[1] Appendix, p. 13773.

Dr. KREPS. With the widest difference of quality and the widest difference in price per pound and price per ton?

Dr. YNTEMA. No, not of the widest difference in quality.

Dr. KREPS. Do you have the range with you?

Dr. YNTEMA. No. Let me point out now, if you are leading up to the question of the aggregation of different items, that the relative differences in quality and characteristics of these different products are very much less than the differences and characteristics of the products which statisticians and economists commonly combine in an index of physical volume.

Dr. KREPS. You mean to imply that such large differences exist in, say, the quantity and quality of bushels of a standard grade of wheat or a standard pound of sugar, with which ordinary demand and cost studies are concerned?

Dr. YNTEMA. No; that is not the point I was trying to make. I was merely saying that many of the indexes which are used, issued by the Federal Reserve Board and by other agencies of the Government, are indexes of volume of production composed of such different commodities as iron and steel, chemicals, textiles, and so on. What I am saying is that the various steel products are more like each other than the different components included in those indexes of volume of production which have good standing among economists and statisticians.

Dr. KREPS. But you are measuring here the cost per ton of a theoretical unit called steel in which the composition of steel varied, did it not? For example, in 1932, did the figure of 11 percent for items other than steel hold true, or was it considerably higher?

Dr. YNTEMA. I can't tell you, offhand, what the situation was.

Dr. KREPS. You did not stop to see whether the composition of the unit which you have asked us to accept as homogeneous was actually homogeneous throughout the period?

Dr. YNTEMA. No; we never asked you to accept the composition of the unit as homogeneous. That is not a correct description of any index number of this type or any other sort. What we did do was this. Instead of just adding tons of different products, we assigned higher weights to the higher-cost products, lower weights to the lower-cost products.

Dr. KREPS. Based on values in some year?

Dr. YNTEMA. Based on mill costs.

Dr. KREPS. On the average for the period?

Dr. YNTEMA. Over a period of 5 years, from 1933 to 1937, inclusive. I should say this—speaking strictly as a professional statistician—that I would stack this index up with any index of production that you would care to name, and I should say that this would represent the variations in volume for the products covered by the index with at least as high a degree of accuracy as any index you can name.

Dr. DECHAZEAU. I would just like to raise the point that the validity of an index depends entirely upon the use to which it is put. You may have production indexes which cover a much wider variety of products than the production index used here, but if it is used merely to indicate a trend in production and not used to determine a cost, it seems to me that it would have inherently a greater validity. I wonder whether Dr. Yntema would comment on that.

Dr. YNTEMA. I would say this, that I regard this index as being more than reasonably acceptable for the purposes to which we have put it.

Dr. KREPS. You would regard this cost curve as being as acceptable as the cost curves of special products which the United States Tariff Commission publishes in its cost studies?

Dr. YNTEMA. The curves used by the United States Tariff Commission, if I remember correctly, are of a very different type.

Dr. KREPS. They are also accounting costs, are they not?

Dr. YNTEMA. Yes; but if I remember, they represent a frequency distribution of such costs. I don't like to get into such technicalities, but I must point out that those so-called cost curves of average cost of individual concerns, are entirely different from this type of study we have presented.

Dr. KREPS. They are likewise cost curves for the industry, the only difference being one of arrangement of the units. But let us restrict the question to the nature of the unit. If I may be permitted an analogy, what you have done is tantamount to taking a population of 50,000 individuals of variegated races and tongues and nationalities and asking us to accept a figure for average height and weight as meaningful when the number of children or of Chinese varies from 1 percent in 1 year to 20 percent or more in another year.

Dr. YNTEMA. May I put the question——

Dr. KREPS (interposing). The unit itself is what I am talking about, not the arrangement.

Dr. YNTEMA. Would you say that an index of physical volume such as prepared by the Federal Reserve Board is useful to show the approximate fluctuations in the volume of business for the industries included in that index?

Dr. KREPS. What you say you have given us is an actual cost curve, not an index of production. They are not the same nor even similar.

Dr. YNTEMA. No; but the question is fundamentally the same. The question is whether the index represents with reasonable satisfaction the fluctuations in the quantity of these products produced. The question which I asked you I think is equivalent to the question which you asked me.

Dr. KREPS. The two positions, I submit, are clearly stated, which is all that is required.

Acting Chairman KING. I wondered whether Dr. Kreps in his analogy of 50,000 population with only 1 percent Chinese was measuring their physical or their mental or their other qualities, their capacity for work, or their capacity for idleness.

Dr. KREPS. It would make no difference what quality you selected, when you have a unit which is as heterogeneous, which, if I may say so, sir, is as nondescript a theoretical hash of varying composition as is the unit called "ton of steel" in this analysis, the result obtained is subject to a considerable amount of debatable evaluation. Now I want to say immediately that if I had been in Dr. Yntema's shoes I might have tried to do exactly what he did.

I also want to point out, however, that for purposes of evaluation the point which I raise concerning the homogeneity of the unit will be admitted by Dr. Yntema himself as being something which gave him a great deal of worry.

Dr. YNTEMA. Yes; that is correct, but I should say that the range of error due to the point that you make is not substantial for the range of accuracy with which we are concerned.

Acting Chairman KING. Trying to be a little practical and having some little practical experience, having worked on the farm, I was wondering when the farmer raises alfalfa and clover and wheat and corn and potatoes and sugar beets and all farm products, and at the end of the year he balances up his accounts and he has sold so many tons of potatoes, so many tons of corn, and so on, and he finds that he has in the bank $50. He has paid all his bills, all the cost, transportation, sales cost, and so on, and he has only $50 in the bank. It seems to me it would be pretty difficult to go back and say that "My cost of lettuce was so much, my cost of potatoes was so much, my cost of sugar-beets was so much," because the whole activity has been consolidated and worked as a unit in every branch of that industry.

Dr. YNTEMA. That is correct.

Acting Chairman KING. It seems to me that is the important question, what is the final result of his labors during the year on the farm. In nearly every industry with its various activities, its various chains that lead out from perhaps a common center, you are going to have cost problems, of course, various other problems, but after all the question is, Did you make any money or did you lose?

Dr. KREPS. Would I understand you to say, Dr. Yntema, that the knowledge of cost accounting by the farmer and by the Steel Corporation and their knowledge of the costs of individual products was probably not essentially different? They are both essentially equally ignorant.

Dr. YNTEMA. I am in no position to answer that question. I don't know what the farmers know about their costs, and I am not qualified to say how much the Steel Corporation knows about the costs, I mean the costs of various products. I would say this, however. Any allocation of overhead costs to different products is arbitrary; and as soon as you start breaking up your costs, allocating overhead to different products, you obtain a result which is not useful and which is suspect for the kind of purposes with which we are here concerned.

Acting Chairman KING. Proceed.

Dr. DECHAZEAU. If what you were really interested in was whether the Corporation did make a profit or did not make a profit, would you have gone to all this trouble

Dr. YNTEMA. No; that is not the reason for, nor the objective of, the analysis. I have stated our objective several times and I don't think a restatement would clarify it, so I should like to proceed with the discussion.

In dealing with our analysis of steel prices, volume and costs, Dr. deChazeau raised a large number of detailed questions. We appreciate these criticisms and the careful scrutiny which this document received. Both Dr. deChazeau and some committee members attached great significance to the extrapolation of the straight line representing the relation of costs to volume, to the zero point of production, and to this $182,100,000 of fixed costs determined thereby. The point was made that this extension beyond the range of data might be subject to considerable error and that, if in error, it would

seriously affect the validity of the results shown by the study. This is not the case.

Dr. KREPS. There are statistical means of measuring that error, are there not?

Dr. YNTEMA. Let me go on and explain. This extension merely gives a convenient method of breaking the total costs into two groups: Fixed costs and additional costs per ton.

Referring to chart B-1 in "Exhibit No. 1409",[1] entitled "Relationship Between Total Costs of Operation and Volume of Business, 1938 Conditions," instead of using this $182,100,000 we could just exactly as well have started from this point and said the total costs of producing 4,000,000 weighted tons of tonnage products shipped was $405,000,000, and that proceeding beyond that point but staying within the range of the data, that the additional cost of operations per additional ton of products shipped was reflected by the way in which this line rose, the slope of the line, namely, $55.73 per ton. The question of the extension of this line beyond the range of the data is entirely immaterial to the point we are trying to make. It merely gives us a convenient way of stating our results.

Dr. DECHAZEAU. I would like to point out that that point was greatly overemphasized in the discussion yesterday merely because the question was raised. I indicated, I believe, that the extrapolation of the figure of $182,000,000 is of little importance for our purpose. It is rather the character of the regression line and the rate at which it rises, and the important thing in my mind was the fewness of observations and the possibility that with changes in the allocation of costs you might get a different type of distribution; that is the important thing, not the extrapolation. I should admit what Dr. Yntema says.

Dr. YNTEMA. Yes, Dr. deChazeau is entirely correct in this latter statement. I should be in complete agreement with it. The important question with reference to additional cost is the slope of this line.

Acting Chairman KING. Will you identify it so persons reading the record may determine the points to which you are directing attention?

Dr. YNTEMA. The important question is the way in which the dotted line in the chart rises with increases in volume.

From inspection of the points, I submit to you that, as far as this particular evidence is concerned, a straight line represents as satisfactory a description of the data as it is possible to obtain.

Dr. KREPS. That assumes, first, that each point such as the cost in 1929 is accurately established, that there were no errors, say, in allowance for obsolescence made by the management in 1929 which they were not aware of until 1931 and '32.

Dr. YNTEMA. I shall come to that point shortly. I should not accept your statement as it stands.

Dr. KREPS. Second, you have absorbed two degrees of freedom, have you not, in producing that line?

Dr. YNTEMA. Quite so. It is the minimum possible number of degrees of freedom that you can absorb. I don't think we should bring this in.

Dr. KREPS. Wait a minute. For any average to be useful, and this is a form of average, you need at least 30 observations.

Dr. YNTEMA. You do not.

[1] Appendix, p. 13773.

Dr. KREPS. For instance, if one person has an income of a million dollars, and the other has no income, the two will have an average income of half a million dollars a year, will they not? Such an average is misleading, is it not?

Dr. YNTEMA. No; that is not correct. You do not need 30 observations.

Dr. KREPS. Then you need to correct by advanced statistical methods for the fewness of the number of your observations, do you not?

Dr. YNTEMA. No. Let me put this in plain English. You do not need 30 observations to make a reasonable case with reference to the relationship between two variables such as dollars of cost and tons of production. If these points in the chart B-1, were scattered widely, I should say that any line drawn through them would have relatively little reliability. If these points were scattered in such a way that every one of them lay precisely upon a straight line, I should say that there was almost certainty that the relation in question was a straight line relationship. These points do depart slightly, but very slightly, from such a straight line relationship, and I submit that this straight line represents if not a relationship of absolutely perfect reliability, at least a relationship of rather high reliability.

Dr. KREPS. This, of course, is a summary chart. The underlying data do show much of the wide scatter that Dr. Yntema is talking about. This may be an instance such as Dr. Warren Persons, one of the initiators of this technique, frequently warned against, in which the errors or residuals due to errors of fit are perfectly correlated.

Dr. YNTEMA. I should like to attempt to get some perspective with reference to the cricitism of the cost analyses which have been offered to this committee. I had the feeling yesterday, as I listened to the discussion, that the points suggested were, from a technical point of view, most interesting, and I was very pleased to have them called to our attention.

Acting Chairman KING. You mean the testimony of Dr. de Chazeau.

Dr. YNTEMA. Yes, that is correct. I had the feeling, however, that perhaps those who listened to the testimony might not be able to see the woods for the trees, and I should like, if I can, this morning, to put these things in their proper perspective.

First of all, I should like to call attention to various concepts of cost. In the long run, when a businessman is considering whether or not he shall build a plant and engage in a business, all the costs are additional costs, there is no overhead, with reference to a problem of that type. So if you take a long-run point of view, all costs must be regarded as additional.

Dr. KREPS. Would you like to make your observations on costs after our witness on costs has presented his testimony?

Dr. YNTEMA. I think it is very important at this point to do this.

Dr. KREPS. Then please do so.

Dr. YNTEMA. Because Dr. deChazeau has raised a fundamental issue with respect to the interpretation of costs.

Acting Chairman KING. Proceed.

Dr. YNTEMA. There is no possible quarrel among us, I think, with reference to the additional costs. All costs are additional in the long run.

In the second place, if I interpreted the statements yesterday correctly, we were criticized because our costs were static, not dynamic, that they did not reflect other elements which changed in the business situation as the volume of production by the steel industry changed.

Then, if I understood the criticism correctly and some of the suggestions which have been made this morning, we were criticized because our costs were not static enough. Now, I submit to the committee that you must choose which concept you want to use in the particular problem, and I suggest, therefore, that we keep clearly in mind two ideas: First, what you might call dynamic costs, which represent the actual history of costs, that is, the actual costs involved at these various operating rates, without attempting to eliminate in any way whatsoever the effect of changes in efficiency or the effect of changes in wage rates and other factors.

Now, if you want such a picture, we have it here——

Acting Chairman KING (interposing). Identify it.

Dr. YNTEMA. In chart 1 of "Exhibit No. 1416", entitled, "Total Costs (Unadjusted) and Volume of Business; United States Steel Corporation and Subsidiaries."[1] On the vertical scale is plotted millions of dollars of actual costs incurred by the Corporation. Along the horizontal scale is plotted millions of weighted tons of all tonnage products shipped.

The fluctuations in total cost and in tons of products shipped—actual fluctuations without any adjustment whatsoever—are reflected in this chart. Now, if that is what you are interested in, how actual costs did fluctuate with volume of operations, here is the picture.

I am not advocating this as an entirely satisfactory picture because the other dynamic elements in the situation did not stay the same in different business cycles; I am not advocating this as a statistically useful concept, but only as a representation of what did happen. If you extend this line, you will find that the fixed costs were lower than those represented in the other chart—B-2 of "Exhibit No. 1409"[2]—that they amounted to some 120 millions of dollars.

The average slope of this line, if we may take a straight line to represent the data—the fit is not so good in this case—the slope of the line in chart 1 in "Exhibit No. 1416"[3] is such that the increase in cost per additional ton of product shipped is approximately $54.51. Now, that is something of a coincidence, that the additional cost in this case of unadjusted total costs turned out to be approximately the same as the additional cost in the case of the adjusted figures.

Let me go on and point out furthermore that this average line reflects the changes in cost at wage levels prevailing when the wage rates were lower than they are today, except for the last few years. It is however, also probably true that the wage rates today are more inflexible than they were throughout this period, so that in the future, if you made up a chart of this sort, some factors would tend to make the additional dynamic costs higher and some of them lower than they are shown in this chart. I do not put a great deal of reliance in it, but if you want a concept of how costs do change in the business cycle, without attempting to adjust for other factors, I submit this is the best evidence which we have available.

[1] Appendix, p. 14039.
[2] Appendix, p. 13775.
[3] Appendix, p. 14039.

Dr. KREPS. Wouldn't you rather say, how the allocation of cost changes?

Dr. YNTEMA. No; I should not.

Dr. KREPS. Might not this——

Dr. YNTEMA (interposing). This shows you how the total costs change. There is no question of allocation here except insofar as costs may not have been charged into the years in which you would like to see them charged. There is some variation possible in some of these costs, in charging them to one year or another. I shall come to that point very shortly in dealing with the adjustments we have made.

Dr. KREPS. Is it the accounting policy, do you know, to charge costs to shipments as shipped? Is there a uniform managerial accounting policy, in that regard?

Dr. YNTEMA. That is a big question. What do you mean by uniform?

Dr. KREPS. There are various ways of allocating depreciation, depletion, and all the other items that are subject to managerial discretion and managerial policy?

Dr. YNTEMA. That is correct.

Dr. KREPS. Now, you can allocate those in various ways?

Dr. YNTEMA. Well, within some range.

Dr. KREPS. That is correct.

Dr. YNTEMA. And the range can be very narrow in some instances, and in others relatively large.

Dr. KREPS. But your evidence shows here that the allocation of cost as historically made varies uniformly with shipments, does it not?

Dr. YNTEMA. No; I did not say that.

Dr. KREPS. Is it not rather uniform?

Dr. YNTEMA. No; I said the costs vary——

Dr. KREPS (interposing). Costs as determined and allocated by managerial decisions determine how much of depreciation and depletion and other items you——

Dr. YNTEMA (interposing). I should like to get the subject clearly in mind in that sentence. It isn't the allocation necessarily that varies; that is something to be investigated. The total costs do vary with the shipments.

Dr. KREPS. I see; that is what I wanted to get straight.

Dr. YNTEMA. The second question is a reference to allocation and I propose to take that up later.

Mr. HINRICHS. When you say that these are actual costs, the businessman understands immediately what you mean. From the layman's point of view, these things that you refer to as actual costs represent, in the first instance and for the largest part of the total, out-of-pocket expenses with reference to which there is no question, plus an accountant's allocation which necessarily involves questions of judgment, and there is in that fact some policy question in terms of how high those costs are?

Dr. YNTEMA. Yes; that is entirely correct and I am glad to have the question because it is one of the points to which I wanted to address my remarks in the next few minutes.

Mr. WERNTZ. May I ask there, wouldn't it be possible for the management to allocate cash maintenance costs between the years?

Dr. YNTEMA. Would you let me come to that in just a moment? I think we will get a more systematic treatment of the subject if you could defer the question for the time being.

ANALYSIS OF OPERATING COSTS

Dr. YNTEMA. As I said, I think it is useful to get some perspective, and I suggest that as a means of procedure, we refer to Table 8 in "Exhibit No. 1416",[1] this table being entitled, "Analysis of Operating Costs into Components, United States Steel Corporation and Subsidiaries."

Mr. O'CONNELL. What is the name of the pamphlet?

Dr. YNTEMA. It is "Exhibit No. 1416."

Mr. O'CONNELL. Yes; but the name?

Dr. YNTEMA. It is entitled, "An Analysis of Steel Prices, Volume, and Costs—Controlling Limitations on Price Reductions."

For the period 1927 to 1938, the costs in the various classifications are there aggregated. The total costs for that period excluding certain miscellaneous items not connected with operations, amounted to approximately $7,900,000,000. Of that total, two components accounted for a very large proportion, namely, pay roll, $3,614,000,000, which accounted for 45.8 percent of the total. (Percentages are not in the table, I am supplying them from other computations.)

The item "Other expenses" on the extreme right of the table accounted for 38.1 percent. Those two expenses, pay roll and other expenses, accounted together for 83.9 percent of the total expenses.

Dr. KREPS. Could you give us some illumination upon what "Other expenses" are? It is such a large item, almost as large as pay rolls.

Dr. YNTEMA. Yes; may I come to that in just a moment? I want to take up in detail the adjustment of these items.

Of the remainder, depreciation, and depletion, concerning which you may hear much in the discussion, accounted for only 8 percent of the total; taxes, other than Federal income and profits taxes and social-security taxes, accounted for 5.4 percent of the total; the other items are minor: interest, 1.5 percent; pensions, 0.9 percent; and social-security taxes, 0.4 percent.

I suggest, therefore, that we focus our attention primarily on those items which constitute the bulk of the costs, because it is only substantial errors in those items which could seriously affect the results obtained in our adjusted costs.

From chart B-2 in "Exhibit No. 1409," also appearing in "Exhibit No. 1416," entitled, "An Analysis of Steel Prices, Volume, and Costs," as chart 13 [2] in that document, the chart title being "Composition of Total Costs of Operation in Relation to Volume of Business," it is possible to get visually some impression as to the relative importance of these components. It is easy to see that the pay roll is the biggest item in the total; that the goods and services purchased from others constitute the next biggest item in the total; and that in comparison with these two, the other items are of relatively minor significance.

Let us consider the pay roll. The pay roll represents the out-of-pocket expense of the Corporation for salaries and wages. Of that total, the salaries account for a relatively small proportion. That is

[1] Appendix, p. 14040.
[2] Appendix, p. 14057.

represented in one of the charts which has been submitted to you, chart E-4 of "Exhibit No. 1409," [1] and if you care to have it shown, we can offer it on the easel.

Mr. HINRICHS. Pardon me, but are bonuses to officers included there? I don't know the Corporation policy.

Dr. YNTEMA. Yes. I am informed that there have been no bonuses in the Corporation since 1930. If I am incorrect in that, I should like to have some official of the Corporation correct me. Before that time, bonuses must have been a very small proportion indeed of the total pay roll. I think that that would be an inconsequential item.

Acting Chairman KING. Proceed.

Dr. YNTEMA. I do not think there is much question, therefore, about the allocation of the pay roll as among the various years with reference to whether or not the individuals rendered the services in those years. There may later be some discussion about pay roll for maintenance purposes and that we can take up when the point is raised.

Dr. deChazeau did call into question a point which is dealt with in this next chart. It is E-17 in "Exhibit No. 1409," [2] entitled, "Earnings Per Hour and Production, United States Steel Corporation and Subsidiaries, April 1937, to November 1939." On the vertical scale is plotted the earnings in cents per hour, and on the horizontal scale, millions of tons.

This represents the relationship between average hourly earnings of all employees and production, that is, the monthly production of rolled and finished steel products.

What is apparent from this chart is that the average earnings per hour do not go up or down as production changes. During this period the wage rate level did not change. Therefore, given a certain wage rate level, the average earnings per hour do not fluctuate up and down with the rate of operations. It is, therefore, appropriate in adjusting the pay roll factor for variations in the wage rate, to divide the total pay roll by the average hourly earnings to find out what the pay roll would have been if the wage rate did not change. Perhaps I should repeat that again. We have here in our original series total pay roll per year. From the period 1927 to 1938, there were variations in wage rates. Our adjustment consists in dividing the total pay roll by the average hourly earnings, and as the chart which I have just shown indicates, that does not involve dividing this total by something which is related to volume of production. That gives us an approximately correct adjustment for variations in wage rates. I don't claim it to be perfect, but it seems to me on the basis of the evidence that it is a reasonable adjustment.

Mr. APPERT. Dividing by average hourly earnings converts the respective pay rolls into the man-hours for that year and then multiplying by the average earnings for 1938 gives us the estimate of the pay roll under 1938 wage rates.

Mr. HINRICHS. What you are saying in effect is, you are taking a record of man-hours worked which you needed in order to arrive at average hourly earnings and are multiplying by the prevailing average hourly earnings in 1938.

Mr. APPERT. Because the evidence indicates the average hourly earnings are not dependent upon the rate of operation.

[1] Appendix, p. 13871.
[2] Appendix, p. 13889.

Mr. HINRICHS. All you needed of this chart was to demonstrate that within the period 1937–39 average hourly earnings had not been significantly related to volume; you are inferring from that period and the behavior during that period that that same thing was true during the earlier periods which is a reasonable inference from the materials that you have, but might be itself subjected to check.

Dr. YNTEMA. Yes, that is correct. If you would examine the detail of the adjustment which appears in table 12, "Exhibit No. 1416," "An Analysis of Steel Prices, Volume, and Costs," [1] you would find some further light on your question. You will notice that for the first 5 years, 1927 through 1931, the average earnings stayed almost constant, although there were fairly considerable changes in volume over that period, and you could by inspection of the adjusted figures find out whether the relation of those observations to volume was roughly the same as some of the others. That is merely an additional check upon the calculations.

We don't claim perfection for this. If we could have made a direct index of wage rates and salary rates, we would have preferred to do it that way. We have used the best technic we can, and we leave it to your judgment as to how satisfactory you think it is.

The second point to which I should like to call your attention is the component of goods and services purchased from others. (Referring to chart B–2 of "Exhibit No. 1409," entitled "Composition of Total Costs of Operation in Relation to Volume of Business.") [2] The adjustment of that item is, I think, the crudest part of our statistical analysis. Let us be quite frank about it. I should have been much better satisfied myself if it had been possible to take the goods and services purchased from others, to break them up by classes, and to make an index number of the prices for each one of those classes and then bring the aggregate together again after adjustment. It was not possible to do that.

The goods and services purchased from others are composed of such items as raw materials, supplies, freight-in on materials and supplies, public utility services, professional services, and so forth; it is an extremely heterogeneous group.

Some of those items fluctuate in price rather widely in the business cycle. Some of them fluctuate not at all. Now, this is what we have done: We simply took the bull by the horns and decided, "We will divide this item into two parts, half and half; one-half we will deflate by dividing it by the Bureau of Labor Statistics Index number for all commodities, excluding food and farm products, and the other we will leave as it is, and then we will add the two results together."

That is a very rough, crude statistical procedure. Let's be perfectly frank about it. If we had been able to do it in a more satisfactory way, we should have taken that procedure. Let me point out, however, that even though you had deflated the total of that item by an index number, the Bureau of Labor Statistics index number of wholesale prices for all commodities, excluding only food and farm products, the resulting difference in the additional cost per ton would only have amounted to about $3. You get some idea, therefore, of the possible error which might be induced because of the incorrectness of our adjustment. It is not serious.

[1] Appendix, p. 14042.
[2] Appendix, p. 13775.

Mr. REYNDERS. $3 per ton?

Dr. YNTEMA. The additional cost would have varied if we had over-corrected by $3 per ton. If there is an error due to this, my estimate is that it must be a relatively small item, even at that. This, I should say, is one of the crudest parts of our analysis. If I were to criticize this myself, that is one of the points to which I should call attention; even at that I don't think it vitiates the general results, the general order of magnitude which we show here for additional or variable costs and fixed costs.

Dr. KREPS. In terms, however, of your average output, 10,000,000 tons, $3 a ton is $30,000,000 profit, is it not?

Dr. YNTEMA. That is not very large in relation to the total cost.

Dr. KREPS. And also not very large in relation to net profit?

Dr. YNTEMA. That is not a correct interpretation because if the additional costs are reduced, the fixed costs are raised, so that it isn't $30,000,000 difference in profit. That is not a correct interpretation.

Dr. DECHAZEAU. There is a question still, of course, to be discussed as to the possible allocation of goods and services purchased in one year with relation to volume which would tend to bias your curve in the direction of increasing your apparent variable cost.

Dr. YNTEMA. Both ways.

Dr. DECHAZEAU. Possibly both ways.

Dr. YNTEMA. Yes, and let me point out why. What is the effect of inventory adjustments in bad years?

Dr. DECHAZEAU. Are you asking me the question?

Dr. YNTEMA. Yes.

Dr. DECHAZEAU. You have the inventories and the data; I suggest that you tell us.

Dr. YNTEMA. The effect of inventory adjustments in bad years is to increase the cost in the years of low operations.

Dr. KREPS. And decrease the cost in the years of high operation.

Dr. YNTEMA. Yes, and that makes the curve too flat and, therefore, makes the additional cost too small. I mean that particular item gives rise, you see, to a bias of exactly the opposite sort from this which you have been discussing.

Dr. KREPS. Have you taken care to avoid that bias?

Dr. YNTEMA. No; we have not adjusted for that. We recognize there are some elements of bias one way and some elements of bias the other way.

Mr. HINRICHS. Where are inventory adjustments in other expenses?

Dr. YNTEMA. They would be included in all other expenses of shipment. What we had to do was this: We had only the consolidated statement available since we had separate figures on pay rolls, and we took those out. There are some slight compensatory errors in the distribution of these expenses between pay rolls and goods and services purchased from others. One may be a little too large in some years when the other is a little too small, but the effect of inventory charges into cost of goods sold would appear here in goods and services purchased from others.

Mr. HINRICHS. While I have interrupted, you said in answer to a question by Mr. Kreps that in view of the magnitudes which were involved that run up to a billion dollars a year, pretty nearly, at times, that $30,000,000 was a relatively small item.

Dr. YNTEMA. In relation to the costs; not in relation to profits.

Mr. HINRICHS. No, no; that a question of estimating the location of one of these points, $30,000,000 one way or another, was relatively small against the total magnitudes that you have plotted there.

Dr. YNTEMA. I'm sorry that I made that statement. I was incorrect in so doing. That is not true, of course. The 30 million item in the case of a billion-dollar cost would be 3 percent and in the case of $500,000,000 cost would be 6 percent, and that is a substantial deviation.

Mr. HINRICHS. You are too good. I thought I was going to have to stop you from letting 30 million go by because I don't want that much.

Dr. DECHAZEAU. May I clear up one thing? In connection with the inventory adjustments, you are dealing, as I understand, not with costs of goods manufactured but with cost of goods sold.

Dr. YNTEMA. That is correct.

Dr. DECHAZEAU. When would the cost of goods taken into inventory be charged, then, in terms of your total expense?

Dr. YNTEMA. Any inventory adjustments, writing down of inventories at the end of the year, would increase the cost of goods shipped, would increase the total cost charged into operations in that year.

We come finally to this index of shipments which has been the subject of considerable discussion this morning as well as yesterday afternoon. If I were asking questions about this index, I would ask this question: There is a proportion of the products of the Corporation not covered by this index. I should raise the question whether or not the production of those products varied in proportion to the production of the products we have included. We do not have satisfactory measures of quantity of shipments for all those other products. We do, however, have revenues, and this I will say, that based upon a study of the fluctuation in revenues of these other commodities not included, and upon a study of the revenues of those commodities which are included, the inclusion of those additional commodities would not make any substantial difference in the index number. And I would say this further, that if you set 20 different statisticians or economists to work on the construction of this particular index number, they would come out with nearly identical answers. If there is a possibility of agreement on something, I should say it is here. I am quite willing to defend this particular index, as a reasonably satisfactory measure of production, to the last ditch.

There were many points that were raised which I have not discussed. I don't like to leave those points without answer to them. On the other hand, I am extremely reluctant to take the time of the committee to discuss details which in my opinion are relatively insignificant. I don't think they are really important in the total. I am perfectly willing, however, to answer any questions, if any member of the committee or any witness for the Government would like to raise such question with reference to the significance of any item in the cost analysis.

Acting Chairman KING. Dr. Kreps, are you through with the witness?

Dr. KREPS. Yes. The witness has made advanced comment upon the presentations which follow, and I suggest, therefore, that the presentations which follow be regarded as presentations of the other side of the case.

Dr. YNTEMA. May I say, Dr. Kreps——

Dr. KREPS (interposing). It was impossible to avoid it.

Dr. YNTEMA. Let me say this. Because of the fact that I had five documents prepared by Government witnesses, I have not, as a matter of fact, had an opportunity yet to read Mr. Taitel's statement. All I have learned is through comments from Mr. Appert, so in responding, I could not have directed my remarks pointedly to the argument that Mr. Taitel is about to make.

Mr. HINRICHS. Will Mr. Yntema be available again?

Dr. KREPS. I should like to recall him after Mr. Ezekiel and Mr. Taitel have presented their case.

Mr. REYNDERS. Will that also be true in regard to Dr. deChazeau?

Dr. KREPS. No, Dr. deChazeau has an original presentation of the Department of Justice which does not strictly belong to Dr. Yntema's analysis. Dr. deChazeau may be dismissed.

Mr. REYNDERS. I won't be able to be here this afternoon, and I just wondered whether I would have an opportunity to clear up some points in Dr. deChazeau's testimony.

Acting Chairman KING. Proceed.

Mr. REYNDERS. One statement you made was to the effect, as I understand it, that while a 10 percent reduction in price might not have a substantial effect upon demand, that a 20 percent reduction would have that effect.

Dr. DECHAZEAU. Yes, that statement was made not with relation to any analysis, you understand, of demand, but merely derived from the point that in the short run the substitutability of one raw material for another, steel for other products, would be likely to be costly and likely to be very small, and that particularly where the price of complementary goods is not altered, is assumed constant, the increased demand for a given product may have quite an elasticity. The point is made that with a very large decrease in the price of steel the demand might have a different elasticity than with a small decrease because of those obstacles to substitution and to increased demand involved in unchanging costs of complementary goods.

Mr. REYNDERS. On the other hand, your argument visualized a reduction of 20 percent in steel prices. Isn't that true? I mean leaving it to the discretion of the committee sitting here, it would seem that a 20 percent reduction in steel prices would be something that was reasonable in the order of possibility.

Dr. DECHAZEAU. The percentage used was purely as a matter of illustration, merely to draw distinction between a small price decline and a large price decline. There was no measure there of what I should consider possible.

Mr. REYNDERS. Would you wish to withdraw that suggestion of a 20 percent, or would you still have it in the picture?

Dr. DECHAZEAU. I think I have withdrawn it as a statement of what I consider to be a reasonable reduction in steel. My point was merely that a large price reduction may have quite a different effect from a small price reduction.

Dr. KREPS. I was going to ask Dr. deChazeau, if one takes a particular product, such as automobile sheet steel, hasn't there actually occurred more than the 20-percent reduction to which you referred? Wasn't that the example which you had in mind, or one of the examples you had in mind?

Dr. deChazeau. There are examples of such price reductions, but my point was a purely theoretical point, as to the significance of the price elasticity of demand in the short run.

Mr. Reynders. The instance that Dr. Kreps suggested was, I think, influenced very largely by improvement in the means of production, and that gets into the continuous mill, which we know has a very big reduction.

Dr. Kreps. Which is one of the benefits of low costs, particularly when producers are forced to lower costs.

Acting Chairman King. Suppose we let the witness proceed. We will not interrupt you with questions until we get through.

Mr. Reynders. Well, I think for the general understanding, it should be clearly appreciated that the distribution of the sales dollar of steel, taking the year 1938 [1] was divided 45 cents for labor, 38.9 for goods and services purchased, as shown there, and 8 percent for taxes, making a total of 91.9 percent going out, which is out-of-pocket expense for any manufacturer of steel.

Now, the committee here is engaged upon an investigation which will give the Congress a correct picture of the possibilities of this industry, and, for that reason, I am very anxious that no impression should go forth that any reduction of that sort is in the range of possibilities, taking it through the whole range of price.

Dr. deChazeau. May I answer that briefly, that the total expenditures made by the Corporation for these various items do not represent what are the additional costs, associated with a given product. Many of those costs are constant.

If your statement is that the Steel Corporation, in view of those expenditures, could not take a 20-percent reduction in its revenue without loss, I should admit it, but I should say that this would have nothing to do with the possibility of reducing the price of a given steel product 20 percent.

Mr. Reynders. Well, that is possible along the line indicated, where the means of production might have undergone a very definite change.

There is another point, Mr. deChazeau, that came up in the latter part of your testimony, that had to do with your suggestion, or at least you said you disapproved of the size of the units which had grown up in the steel industry and regarded that—I am not in controversy with you at all, but it is from your practical contact with the steel industry—I understand you have visited many plants and you know the general situation, you are familiar with the location of raw materials such as iron mines, coal, and so forth—in that connection, what thought, may I ask, have you given to what is a suitable unit of a steel plant of a steel corporation?

Dr. deChazeau. I have given it considerable thought, but in order to give any statement with regard to it would involve a very complex investigation which we were not able to make.

Mr. Reynders. It is really a very simple one. You can do it in 3 minutes.

Dr. deChazeau. The point to which I made reference was merely this, that when a plant expands through an increase in its production facilities, then there is a self-corrective applied in that expansion through increased cost, in a competitive situation.

[1] Referring to chart A-8 of "Exhibit No. 1409," appendix, p. 13757.

When a plant expands through merger, which in part reduces the competition, the same corrective does not apply. Therefore, I think that one can be suspicious of expansions by merger. Now, when one presents evidence that the total costs of the Steel Corporation are so large that they cannot make a profit, whereas other companies less well integrated or less thoroughly integrated, less extended in other directions, are making a profit; then it does not seem to me that the case has shown conclusively that the price of steel is too low. It may be that the Corporation is too large for over-all efficiency.

Mr. REYNDERS. I am not taking the size of the Corporation particularly, because that is something in being, but for the perspective of this committee, having raised the question at all, I think there should be on the part of one who is so experienced as you are in the industry, the ability to indicate what would be a reasonable size of a steel enterprise.

Dr. DECHAZEAU. Well, I should say there that the reasonable size of any integrated steel plant is so large in my estimation that even if you broke up all of these corporations into those sizes, the number of sellers would be so small in the market that each one would have to take into consideration his full effect upon his rivals. If that gives you an answer without putting a dollar figure to it—in other words, I feel that the fundamental conditions in the industry require size. When a continuous mill alone requires an investment of from twelve to twenty-five million dollars, when blast furnaces require an investment of around four and a half to five millions, when your steel furnaces require an investment of upward of $600,000—that is, any integrated firm is likely to have a very large investment and is likely to be a very large plant. Now, whether the actual size of a plant is in excess of efficiency, I am not qualified to make a statement.

Mr. REYNDERS. Well, there is one question: You would regard it as necessary to have diversification of products, that is, you couldn't contemplate a steel plant that devotes itself to nothing but structurals or nothing but plates or nothing but tubes?

Dr. DECHAZEAU. I could not contemplate an integrated plant which confines itself to a single product. The investment is too large to locate itself with relation to any given market or any given product. The operating characteristics of blast furnaces and steel-making furnaces require something close to capacity operation while they are in operation, and therefore, in order to get a balance of utilization over good years and bad and with shifts in demand, you need a multiplication of rolling facilities. For that reason, although you may establish a nonintegrated firm close to a given market, or even possibly a semi-integrated firm, I doubt whether it is possible to locate a fully integrated firm with relation to a given product market.

Mr. REYNDERS. Well, getting down to figures, and what diversification of products means, you are familiar with what is the annual output of a continuous mill layout today?

Dr. DECHAZEAU. Well, of course, it varies with the mill. A flat rolled production of output, capacity output, up to 800,000 tons—some of them are reported even up to a million tons.

Mr. REYNDERS. Now, such a plant, running to capacity, would require from 800,000 to a million tons of ingots, wouldn't it?

Dr. DECHAZEAU. It would probably require more because of conversion losses.

Mr. REYNDERS. Yes. Now, if you add to that, for instance, a structural layout, structural and plates, those two items together would be about the same capacity as the one of the continuous mill?

Dr. DECHAZEAU. What you mean by structural, I take it, is a rolling mill for shapes?

Mr. REYNDERS. I-beams, especially the broad flange beams——

Dr. DECHAZEAU (interposing). You don't mean a fabricating unit?

Mr. REYNDERS. Oh, no; entirely rolled products.

Dr. DECHAZEAU. Well, now you are getting into a field in which it seems to me there are men present here who are better qualified to testify. I cannot. It is, after all, a fairly well-known fact as to what the range in cost in a continuous mill is. When you get me down to special mills, I am not prepared to quote you a dollar figure.

Mr. REYNDERS. I am only leading up to what the reasonable size of the steel plant is, and that is, I think, something which this committee is very much interested in. I am merely bringing up the various items because they are simple, extremely simple, and I think you will find that if you wish to diversify, including structural material and plates, you will have a gain of about 600,000 tons of annual capacity, and no plant of that kind would operate unless they had a barn which would hold several hundred thousand tons. Then you have the category of pipe and wire, which together might mean a half million tons. If you add those together you have something of the order of 1,000,000, well over a million tons of finished products, perhaps a million and a quarter, in fact much more than that—I beg your pardon, it is really up to 3,000,000 tons when I add up these various figures. That, then, would be necessary if you had a diversified organization.

Dr. DECHAZEAU. But those figures are probably very excessive, as indicated by the much lower capacity of integrated mills such as Inland's mill in Chicago, or National Steel.

Mr. REYNDERS. Inland's is about the size I am talking about.

Dr. DECHAZEAU. Yes. I haven't the figures before me.

Mr. REYNDERS. I can figure that; they are probably the size.

Dr. DECHAZEAU. But it comes to a large figure. It is in the order of a million.

Mr. REYNDERS. That is the point I wanted to bring out. I had 3,000,000 tons here for the plant that I have outlined, and that is about the size of Inland. I think there is Youngstown Sheet & Tube.

Dr. DECHAZEAU. Is that total finished rolled capacity or the ingot capacity?

Mr. REYNDERS. That is the ingot capacity. That is the common divisor. I think that Youngstown Sheet & Tube is about the same size as Jones & Laughlin, so it would seem to me perfectly proper to have on record here that a concern of about that size is not unreasonable; that is, when you are talking about units and diversified units, you would reach some such size as we have here, and on the basis of a reconstruction of cost today, if you know what that would be for a ton, annual capacity.

Dr. DECHAZEAU. No; there are men better qualified to give you that figure, but I would like to make this comment: In terms of the actual development of mills you have reached that capacity. Whether that capacity constitutes the minimum which is possible with efficient operations does not remain clear, or rather is not proved, and that is why I hesitate to comment completely on those figures. I should

suggest, however, that the mere order of size in individual plants and integrated groups, assuming that businessmen are interested in efficiency and increasing their profits through efficiency, would indicate that the order of size is large, but I wouldn't comment on a 3,000,000-ton or a 2,000,000-ton or even a 1,000,000-ton size without much more data than I have available.

Mr. REYNDERS. There is another element that enters into this, Dr. deChazeau, and that is geographical distribution and geographical markets to be reached. A plant of the kind indicated here, if located in one particular locality, would of course have restricted markets and even going to this size you are still to an extent a local concern, not covering the entire area of the United States.

Dr. DECHAZEAU. May I say in connection with that that our study of the distribution of products will throw considerable light on that relation of markets to given producing areas; although it will not give a conclusive answer to the question, it will at least throw light on the actual distribution from a given producing area.

Mr. REYNDERS. My object here was to have in the record and for the benefit of the committee an adequate idea as to what size really constitutes and what it means in the steel industry. This type of plant, if constructed on today's prices, would be of the order of about a hundred dollars a ton, and that would then reach the size of about $300,000,000.

Dr. DECHAZEAU. That is right.

Mr. REYNDERS. That was what I had in mind, Mr. Chairman.

Mr. WOODEN. I have a question I should like to ask of Dr. Yntema. Doctor, do you think any clear or accurate conclusion can be drawn as to the feasibility of a reduction in steel prices based upon a cost study which includes the cost of such things as cement, the operation of common carriers, and the operation of coal mines?

Dr. YNTEMA. After all, the operation of the coal mines when the coal is used in the production of steel is just as much a part of steel production as the processes nearer the final products.

With reference to the operations of the railroads, insofar as they carry the products used in the making of steel, they are part of the steel-making processes.

Mr. WOODEN. Insofar as they are common carriers?

Dr. YNTEMA. No; insofar as they carry the products used in the making of the steel, they are part of the integrated steel process.

Mr. WOODEN. And what about cement?

Dr. YNTEMA. In the case of cement you have another industry. I am not familiar with the technological development there. I understand that the cement plants do to some extent use a byproduct of the steel industry, but the point that is relevant, I think, is that the total operations of the cement plants are scarcely a drop in the bucket in comparison with the other items It wouldn't vitiate any findings which I presented here.

Acting Chairman KING. It is important to have iron ore too, is it not?

Dr. YNTEMA. It is necessary in integrated operations, of course.

Acting Chairman KING. In the production of steel. Would there be any objection to a steel company obtaining not only its coal supply but its iron-ore supply as a part of its integrated activity? Would that not make it perhaps to the advantage of the consumer ultimately?

Dr. YNTEMA. Let me say with reference to questions of this type that I am not a steel man and I am not competent to speak on questions of integration. I simply made a study of some phases of this subject. I do not wish to commit myself on matters outside my knowledge.

Acting Chairman KING. The committee will take a recess until 2 o'clock.

(Whereupon, at 12:25 p. m., the committee recessed until 2 p. m. of the same day.)

AFTERNOON SESSION

The hearing was resumed at 2 p. m. upon the expiration of the recess.

Acting Chairman KING. Are you ready?

Dr. KREPS. Yes.

Acting Chairman KING. The committee will be in order.

Call your first witness.

Dr. KREPS. Dr. Mordecai Ezekiel.

Acting Chairman KING. Come forward, please. Doctor, will you hold up your right hand? Do you solemnly swear that the evidence you shall give in this hearing shall be the truth, the whole truth, and nothing but the truth, so help you God?

Dr. EZEKIEL. I do.

Acting Chairman KING. State your name and residence.

Dr. EZEKIEL. Mordecai Ezekiel, Washington, D. C.

TESTIMONY OF DR. MORDECAI EZEKIEL, ECONOMIC ADVISER TO THE SECRETARY, DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

Dr. KREPS. What position do you hold, Dr. Ezekiel?

Dr. EZEKIEL. I am economic adviser to the Secretary of Agriculture.

Dr. KREPS. But as I understand it, you are appearing in no respect as a representative of the Department of Agriculture, but only as an expert on statistical and economic matters, particularly on price analysis?

Dr. EZEKIEL. That is correct. I am not appearing for the Department, but am appearing as an expert in statistical and economic analysis.

Dr. KREPS. How long an experience have you had in the techniques of statistical research employed here by the Steel Corporation?

Dr. EZEKIEL. I have been working approximately 20 years using these methods, and have a textbook, Methods of Correlation Analysis, which presents most of the methods Dr. Yntema has used.

Dr. KREPS. As a matter of fact, it is a standard reference work in this field. These methods were first applied in what field, Dr. Ezekiel?

Dr. EZEKIEL. The methods have been used very widely in the field of agriculture, particularly in the economic analysis of changes in prices and production of farm products, in the Bureau of Agricultural Economics and agricultural colleges throughout the country.

Dr. KREPS. And have you utilized these methods in your economic analyses concerning what might stimulate employment and the like?

Dr. EZEKIEL. Yes, I have used them to some extent in industry. They have been applied much less in industry, however, than they

have in agriculture. I have given a good deal of attention also to the general problem of unemployment and to the steps that industry might take in dealing with the problem of unemployment and low production.

Dr. KREPS. In that connection, it seems to me I remember two books of which you are the author, one entitled "Twenty-five Hundred Dollars A Year," and the other, "Jobs For All."

Dr. EZEKIEL. That is correct. I have two recent books on the general subject of correcting industrial unemployment.

ANALYSIS OF DR. YNTEMA'S STATEMENT CONCERNING PRICES, VOLUME, COSTS, AND PROFITS

Dr. KREPS. Would you care to comment on the general significance of the results which Dr. Yntema has secured in which he has utilized your methods and their bearing, as you see it, on the general problem of unemployment?

Dr. EZEKIEL. Yes, that is what I am now prepared to do.

Dr. KREPS. You have a statement, have you?

Dr. EZEKIEL. Yes, I have a statement summarizing my views on these points.

The material that Dr. Yntema presented may be summarized in three broad statements:

First, that if the steel industry were to reduce its prices at any time, the percentage gain in sales (due solely to the reduction in price) would be at most no greater than the percentage reduction in price, so that in consequence the gross income of the steel industry would show no increase as a result of the price reduction.

Second, if the sales of steel were to increase at any time, the larger output would lead to a reduction in production costs per ton, but those costs per unit would not fall as rapidly as output rose, so that total costs would increase as sales rose.

Third, that reduction in price would always reduce the profits or increase the deficits of the Corporation. That result follows from his argument, since total income would not increase with the increased sales, whereas total costs would increase.

I have been over rather carefully the statistical technics used both in the cost analysis and in the price analysis, and there are a good many individual weaknesses in technic. Other witnesses will discuss the detail weaknesses in the statistical analysis made. The points that I am going to take up here are not differences of analysis, but the interpretation made of the results obtained. What I propose to show is that even for the time accepting the results of the analysis in the Steel Corporation documents, that the conclusions they draw from those results do not necessarily follow.

Acting Chairman KING. Do you mean to state that the factors which they have taken into account do not exist or that they have placed too much stress upon one factor and too little upon another?

Dr. EZEKIEL. No, I am accepting for the time their measurement of the effect of a change in price on quantity sold as measured by their statistical analysis, but I shall draw attention to the fact that there are other concurrent elements in their analysis which they have ignored in their subsequent interpretation. Even though their

statistical analysis is taken as correct, the conclusions they reach are not necessarily the right conclusions.

Acting Chairman KING. You don't mean to state that those in charge of the business, interested, of course, as they are in its development and in the protection of the capital invested and of the labor that is involved, you do not mean to state that they do not try to ascertain the material condition, if I may use that expression, the utilitarian outlook, and then adjust their business to meet the situation, the rise in prices or the decline in the market, in the consumptive demands and so on?

Dr. EZEKIEL. I am not criticizing at all the technics of the industry as it has operated. As I understand it, in fact the industry has operated to this time without having these research results. These research results have just been worked out and apparently, therefore, are something different from the practical basis upon which the industry is operating. I am taking the research material which is introduced as testimony to show that the industry had been justified in not following a lower price policy and am reanalyzing the material to show how quite different conclusions can be reached from the same material.

The statement that they made, that it would never pay to reduce prices, rests upon three assumptions that are made in their analysis, two of which were not explicitly stated in Dr. Yntema's presentation or in the document submitted. Those assumptions are these: First, that a reduction in the price of steel, while it might increase somewhat the quantity of steel sold, would have absolutely no effect on the general level of business activity.

Second, that reductions in the price of steel would have no effect upon the level of prices involved in the cost of producing steel.

Third, that there is no possibility of bringing about concerted action by the steel industry and other industries by which not only steel prices but prices of many other products could all be reduced at the same time, so as to get a much larger stimulus to activity than could be produced from the effect of reducing steel prices alone.

Dr. Yntema referred briefly to this third point yesterday, but not to the other two.

Acting Chairman KING. You wouldn't mean by that that there ought to be sort of a combination between the steel industry and others with a view to raising or lowering prices?

Dr. EZEKIEL. That is the point I will discuss toward the end of my statement.

Acting Chairman KING. Running perhaps head-on with the Federal Trade Commission or with the Sherman antitrust law. You are not advocating that, I assume.

Dr. EZEKIEL. Toward the end of my statement I discuss that point, so if you will permit me, I will put it off until I come to it.

Taking up each of these three points separately, the first is as to the assumption made on the price of steel. The statistical method used in determining the over-all effect of a price reduction on the quantity of steel sold is the method that is known as multiple correlation analysis, a method by which you examine the simultaneous results of several different factors all affecting another factor. By that method it has been determined that the year-to-year changes in steel output and sales in the period since the first World War have been

explained largely by three factors. The first of those factors is the level of industrial activity, or the level of industrial profits and of national income. The second factor is the price of steel, and the third factor is the long-time trend in the demand for steel.

Now, in measuring the effect of changes in each one of those factors on the quantity of steel sold or shipped, the analysis assumes that only one factor is permitted to change at any one time while all the others are held constant. That is, they have measured how much change there would be in steel sales, if the price of steel was either increased or decreased, while business activity did not change and while the trend factor was held constant, and then they have measured how much a change in business activity would affect the sales of steel, if meanwhile prices were held constant and trend were held constant.

From that statistical analysis the conclusion has been reached that if the steel prices were reduced but the other factors were held constant, with no change in business activity and no change in trend, that at best sales would increase no more rapidly than the price fell in percentage terms. That is what the elasticity of not more than one means. But that conclusion in their analysis holds true only if it were possible for steel prices to be reduced while industrial activity meanwhile remained unchanged.

I want to consider for a moment what does actually happen when steel prices are changed. Assume, for example, U. S. Steel Corporation would reduce its price, and as a result of its reduced price increase its production and sales as they have shown. Not merely U. S. Steel would reduce its price and output, but all the other steel companies would reduce their price and increase their production and sales. As a matter of fact, the analysis they present is not the analysis of the effect of price on U. S. Steel sales, but is an analysis of the effect of price on sales of the entire industry. As a result of producing more steel, they employ more men, they buy more materials, and they pay more for the costs of the industry, so the disbursements for the whole great steel industry for wages, material, power and freight, would rise. Not only would disbursements in the steel industry rise, but more steel being produced and purchased would mean that more steel was being used in automobiles and construction, containers, machine tools, and all the other various uses. So that would mean these other industries would also be employing more men, be increasing their pay rolls, be shipping more products and increasing their disbursements. As steel production increases, that carries with it a change in the production of all other industries. Their assumption has been that all the time while the price of steel was reduced, industrial activity has been unchanged, while only the price reductions affected steel sales.

I have brought with me a chart which shows how absurd it is to assume that steel output could change without a corresponding change in the level of industrial activities as a whole. This chart——

Dr. Kreps (interposing). Dr. Ezekiel, for the purpose of identification, would you like to have this chart introduced into the record?

Dr. Ezekiel. Yes; I would.

Dr. Kreps. Mr. Chairman, I should like to offer this chart, entitled, "Relation of Industrial Production, Excluding Iron and Steel, to Steel Sales," for the record.

Acting Chairman KING. It may be admitted, without objection.

(The chart referred to was marked "Exhibit No. 2183" and is included in the appendix on p. 14119.)

Dr. EZEKIEL. What this chart shows is the relation of changes in steel shipments year by year to changes in the level of industrial activity. The way the chart is prepared is this: Each year is represented by a single dot and that dot is placed both according to the million tons of steel shipped that year, and according to the industrial production excluding iron and steel; that is, according to the index of industrial production in industries other than the steel industry.

Now, starting with a couple of low years after the War, thereafter there is a very consistent relation between changes in steel shipments and changes in the level of activity in other industries. Every single time that there was an increase in steel output, there is an increase in the activity of the other industries. For example, here from 1932 to 1933, steel shipments increased from around a little over 10,000,000 tons to about 16,000,000 tons, activity in the other industries increased from about 73 to 82.

Dr. KREPS. Dr. Ezekiel, if you had limited yourself to the same period as Dr. Yntema limited his analysis the dots for 1920 and 1921 would not appear; isn't that correct?

Dr. EZEKIEL. Yes. Those years were not used in his cost analysis.

Dr. KREPS. Then the conformance of the dots to the line would be considerably closer; is that correct?

Dr. EZEKIEL. Yes. You can see, except for those 3 years, how closely all the other dots adhere to the line, showing the average relation between change in steel sales, steel shipments and a change in the general level of activity in industries other than steel.

Acting Chairman KING. May we not postulate increase in steel resulted from the increase in the other activities, instead of the steel being the motivating, the moving cause, that the other industries and activities were the ones, and they had their influence upon steel and caused the increase or rise in steel?

Dr. EZEKIEL. So far as the figures presented in the chart are concerned, they do not tell us which is cause and which is effect. It could be as you suggest, either way.

Acting Chairman King. You don't intend to say that steel is the lever which determines the rise or the fall of the business activities, industrial activities, of our country?

Dr. EZEKIEL. No, I am not saying that steel is the sole cause of changes in business activity, but the point that I am making is that changes in steel production and changes in activity in industries other than steel are so closely associated that regardless of which is cause and which is effect, we have not in fact had changes in one without changes in the other. So that to assume that you could make a material increase in steel production without at the same time having material increase in other industries, is to go against the record of the past period.

Acting Chairman KING. We have been led to believe by some of the earnest and sincere and intelligent advocates of agriculture that agriculture was the principal, the most important, industry and that the condition of the farmers determines the condition of the rest of our economic life; that if agriculture was prosperous, everything would be prosperous, including the steel industry. You are not trying to

minimize the importance of agriculture, you being in the Agricultural Department?

Dr. EZEKIEL. It is true there as here, that large demand for agricultural or farm products is associated with high buying power in the cities, and high buying power on the farm in turn helps maintain city activity. But there, as here, there are two factors that run together, and saying which one is cause and which one is effect, well, all one can say is that they do move up and they do move down together.

Dr. KREPS. Dr. Ezekiel, for purposes of removing all elements of, shall I say, obfuscation, concerning this chart, is there anything technically that can be said against this chart that is not equally true of the other chart; that is Dr. Yntema's chart is taken to prove that the prosperity of the steel industry is dependent on industrial production, such an inference stands or falls on the same analytical and statistical grounds as this chart; if one is admissible, the other is admissible, and if one is not admissible, neither is admissible?

Dr. EZEKIEL. Yes. The type of analysis is the same here as there, that we are reasoning from the fact that certain variables move or do not move together.

Acting Chairman KING. There may be some industries though that are prosperous, profitable, whereas other industries are not prosperous, over the same period?

Dr. EZEKIEL. Well, this chart, of course, does not attempt to measure profits. It simply takes the observed facts as to volume of output and says that the record shows that when there is a large volume of steel output, there is also a large volume of output in other industries; when there is a low volume of steel output, there has always been a low volume of output in other industries. It does not go beyond that point.

Acting Chairman KING. Well, does not the increased output in other industries lead to an increased output in steel?

Dr. EZEKIEL. Opinions can differ on that. I believe, however, that the record will show that the changes in steel production have been more responsible for changes in the total of industrial activity than have the changes in most other industries; that steel production is more variable than the total output of other industries; and that the heavy capital goods, such as steel, may play a predominant part in the business cycle. For example, the output of agricultural products varies only 10 or 15 percent from high to low, whereas the output of steel during the same period has varied from as low as 10,000,000 tons to as high as 35,000,000 tons.

Acting Chairman KING. Well, I can't help but believe that the prosperity of agriculture determines in part at least the prosperity of the steel industry. I recall when a boy, working on the farm, when our products, farm products, brought a good price, we would buy more wagons and more reapers, more mowers, and more steel commodities which we used in connection with agricultural development, and the purchase of those steel commodities, of course, furnished an additional market for the steel industry, so that the steel industry prospered when we prospered; that is to say, their output increased when our output of agricultural commodities had a reasonable price increase.

I don't know which was the chicken and which was the egg there, but I know that the prosperity of the farmers brought prosperity to other branches, including the steel industry, and I cannot quite conceive of the theory that the steel industry is the lever that moves our entire economic and industrial fabric.

Dr. EZEKIEL. Well, if you will pardon me, sir, I am not trying to say that it is the sole lever, but I am trying to say that it is one of the levers. It is quite true, as you state, that when farmers have income and can buy more tractors and more automobiles, that helps the demand for steel, but it is also true that only a relatively small proportion of steel goes into such uses, as compared to the total amount of steel going into railroad cars and the construction industry and all the many other industrial uses of steel, as well as farm machinery and the farm portion of automobiles.

Acting Chairman KING. That would mean, of course, that the railroad industry, which has been one of the largest consumers of steel, when it is prosperous, it adds to the prosperity of the steel industry?

Dr. EZEKIEL. Quite so.

Acting Chairman KING. And if the railroad industry is in the doldrums, as it has been for a number of years, in part due to the development of trucks, waterways, and other means of transportation, it affects quite materially the profits and business of the steel industry.

Dr. EZEKIEL. The sole point I am making at this time is that if a reduction in steel prices does increase the quantity of steel sold, that means more products are being hauled over the railroad, more steel is being used, and there is an associated increase in other industries. That is as far as I am going at the moment.

Mr. HINRICHS. Your materials here are essentially the same as the materials that Dr. Yntema presented when he mentioned the relationship between industrial activity and steel output, and you are merely calling attention to the fact that by virtue of the fact that a change in steel price stimulates to some extent volume of business, there is a secondary reaction, so that if his figure of three-tenths of a percent were to be taken as correct it would inevitably be somewhat larger than that, you are not saying how much larger at this stage of the game, but that there must be some addition beyond the thing that comes from the processes that Mr. Yntema used by virtue of this repercussion from the stimulated industrial activity. Is that correct?

Dr. EZEKIEL. That is the point to which I am now coming. For these statistical purposes it is very convenient to measure the separate effects of business activity and of steel prices on the amount of steel production and shipments, but after that has been done it is quite erroneous to assume that you can reduce steel prices and increase steel sales without at the same time increasing business activity.

The analysis that was presented in the documents in Dr. Yntema's statement yesterday indicated that changes in business activity were about 10 times as important as were changes in prices, in accounting for changes in steel production. The tables in his statistical analysis show that the percent of the variation in steel consumption explained by business activity was of a magnitude about 10 times as great as the percent of the variation explained by steel prices. But then when he came to estimate how much increase in production you get for reduction in price he took into account only the effect of price on sales

and made no allowance whatever for the effect of the associated increase in business activity on steel, so that in considering price alone and in failing to consider the associated changes in business activity, the analysis presented has left out of account the most important single factor. In consequence, it has gravely understated the increase in sales which might be expected to follow from a given reduction in price. For that reason it is quite possible that a reduction in steel prices would cause a very much larger increase in sales than the computations presented assumed, and it is therefore likewise quite possible that sales would increase so greatly with a lower level of price that the gross income of steel producers would rise as the price of steel fell or was reduced.

The second weakness in the analysis lies in the assumption that the price level of the factors entering into steel production would remain the same regardless of the price of steel. It is well known, for example, that steel scrap is an important material in steel production, and it is also customary that scrap prices and pig iron prices move fairly closely together, so that cheaper iron and steel would mean probably less expensive scrap. Furthermore, the analysis of costs presented by the Steel Corporation took into account the wholesale price level as one of the factors with which to adjust the "other costs" item of costs. They show that the material costs move with the general price level. Steel and iron are major industrial products, so that it is not unreasonable to assume that changes in the price of steel and iron may exercise a price leadership not only on steel scrap but throughout many industrial prices. As a matter of fact, the record of the past 20 years does show that steel prices and the prices of other industrial products have moved together quite closely through most of the past 20 years, have had very similar general price movements. So to the extent that both scrap and other industrial prices were influenced by reductions in iron and steel prices, the costs of producing steel would be reduced, at least relative to that which they have shown. So even assuming the accuracy of their cost analysis, it is still quite possible that a reduction in steel prices and an increase in steel output would cause materially less increase in Corporation expenditures than their calculations have shown. You see, I am not criticizing their calculations; I am cricitizing their failure, in estimating the increase in total cost of the Corporation, resulting from an increase in output, to take into account that the lower iron and steel price at which they output was produced would also mean lower prices for some of the products that they were buying, and therefore not as much increase in total cost as they have shown, based upon the 1938 level of prices.

Acting Chairman KING. That is to say, you would be criticizing the steel management for not producing more steel when they got down to 30 or 40 percent of their capacity, or 25 percent, even though at that time they couldn't find a market for the amount of steel which they were producing at that small percentage of capacity. You think they ought to have continued their output, even to have lowered the prices, for the purpose of stimulating activities in other enterprises?

Dr. EZEKIEL. What I am considering is, had they lowered their price, how much of an increase in sales that would have made and how much of an increase in total costs they would have faced. They have presented materials which show that had they lowered their price they

would not have increased their sales any more than they reduced the price, so they would not have increased their gross income, and that they would have increased their total costs materially so they would have lost more by doing it. What I am attempting to show is that their analysis of their own data does not necessarily lead to that conclusion, that they have left out of account certain very important factors, first on the demand side and then on the cost side, which makes the result that might have been obtained materially different from that which they have presented to you.

Mr. WALTER WHITE. On the demand side, Dr. Ezekiel, doesn't it make a difference whether you make your price reduction at a time when industrial activity is increasing or whether you make it at a time when general industrial activity may be static or declining?

Dr. EZEKIEL. I am not an expert in the steel industry, I don't know the answer, but I might say that no material has been presented by the Corporation to show that there is such a difference. The fact that they have never tried reducing their prices during periods of depression to see if they could move more material, that is, reducing prices in the magnitude of the type discussed here, means we don't have any experience to go on. We do know in the field of agriculture that when farmers reduce their prices very greatly they can as a result of those low prices move into consumption just as much as they moved into consumption before. We do know that throughout the depression except when the drought came along, farmers continued to produce almost as much as they had been producing before and moved into consumption that continued output.

Acting Chairman KING. Is that true of cotton?

Dr. EZEKIEL. Yes; by and large it is true of cotton. Even for cotton the very low prices resulted in a sustained domestic consumption of cotton from 1936 to date which was not so much below the predepression levels.

Acting Chairman KING. You are not taking into account the millions of dollars with which we have had to subsidize the cotton industry by reason of the decline in the consumptive demands, closing of markets, the lack of demand for cotton.

Dr. EZEKIEL. The greater part of that loss of consumption was in the foreign market rather than the domestic, and that is outside of the thing I was trying to present now.

Acting Chairman KING. Except by way of analogy. If I had time I would call your attention to the decline in the production of zinc and lead and copper and all of the metals during the period when the prices went down until copper was sold at 4 and 5 cents a pound, perhaps at a loss of 4 or 5 cents a pound, and yet with those low prices it didn't stimulate the consumptive demand of copper.

Dr. EZEKIEL. It is quite true, sir, that most industries have operated the same as steel has operated, and that is the precise point why this question of industrial price policy is so important, because it is true that most industries follow the practice of maintaining their prices with only at most moderate reductions. You mentioned some that reduced more, but most of the heavy industries did not. Automobiles sold in '33 at much the same price as they sold in '29, and they took out the reduction in demand in a greatly reduced output, turning their workers out into the street to take care of themselves, or let the Government take care of them. Farmers take the depression in low

prices; industry takes the depression in low employment and their workers stay idle.

Dr. KREPS. I am not sure that I understand you correctly. You don't mean to say that there has not been a reduction in absolute steel prices during the period from 1929 to 1932, do you?

Dr. EZEKIEL. No, the point I was making is that the reduction in price has been very small contrasted to the reduction in output, and very small contrasted to the reduction in the prices of farm products and many other industrial products.

Dr. KREPS. When we speak of steel prices being relatively high, we mean relative to what?

Dr. EZEKIEL. Well, it depends on the base we use. We may say steel prices are high relative to 1929, or we may say they are high relative to other products.

Dr. KREPS. When you said that the steel prices did not decline, that we had no experience of a decline in steel prices, you meant no experience of a decline in steel prices which was greater, relatively, than the decline in prices in general?

Dr. EZEKIEL. That is correct. I might say also we have very little experience with a decline in steel prices even as great as in the prices of other products.

Dr. KREPS. In general it is true that steel belongs to an order of producer's goods which as Dr. Mills has pointed out in a three volume analysis rose relatively in price during the depression, became relatively more expensive. Is that correct?

Dr. EZEKIEL. Yes, you had to use more of other materials to buy steel; that is, a ton of steel in 1932 and '33 cost a great many more bushels of wheat, or bushels of corn, or bales of cotton, or even suits of clothes, than it did in 1929.

Dr. KREPS. And that is the important point for the problem of investment, and the like, is it not?

Dr. EZEKIEL. It is one of the important points; I wouldn't say it was the exclusive one.

I have considered the price analysis presented and the cost analysis presented, and I have shown that even accepting the results secured by the accounting and statistical technics used in the studies presented by the Corporation, that there still remains the probability that a reduction in price would produce more increase in income and less increase in cost than the Corporation has assumed. In consequence, a reduction in price would cause less increase in deficit than the Corporation assumes and might even produce an increase in profit.

This reinterpretation of the results of the analyses presented may prove of interest to many of the people in the steel business who may have been puzzled by the dilemma to which the original analyses led. As these analyses stood, they sum up in this conclusion, which was stated on page 38 of "Exhibit No. 1416," entitled "An Analysis of Steel Prices, Volume and Costs," and I quote:

> That unless the elasticity of demand for the product exceeds 1 by a substantial margin, the theory that price reduction in and by itself would produce profits through increased volume is utterly fallacious, not only for the United States Steel Corporation, but for any business or any industry. * * * Application of the theory of increased profits through price reduction could thus only produce loss to the enterprise which adopted it.

If that statement were turned the other way around it would equally have proved that any industry situated as the steel industry is situated, would increase its profit by increasing its price and reducing its output, since to increase the price would bring an increase in total income, while the reduced volume would produce a net reduction in costs.

So that many other industries in the same position at the same time could all make more money by producing less product and by selling it at a higher price. That is the conclusion which the steel analysis leaves.

They don't carry it to that point, but presumably the largest profit would be reached when 1 ton of steel was produced by the industry and sold at a price of a billion dollars a ton, since that would involve practically no cost except the fixed cost and you would have all profit. It is obvious if all corporations attempted to follow this theory at the same time that not only would most workers be unemployed, but nobody would be able to pay the high prices for the product.

FAILURE OF HIGH PRICES TO PROMOTE BUSINESS

Dr. EZEKIEL. So the theory that all businesses can make more money by all producing less and all charging higher prices at the same time obviously cannot be true. It may be comforting to those who have been troubled by this fundamental dilemma to which the results lead that these conclusions rest upon a very narrow view of the industrial process and only hold true on the assumption that the steel industry operates without effect upon the rest of the economy.

The reinterpretation I have just presented may be summarized briefly in the statement that the conclusions of the Steel Corporation have made no allowance for the fact that with changes in the prices of iron and steel products and the volume of steel operations there would also be associated changes in the prices of other products and in the volume of operation of the economy as a whole.

So when allowances are made for that broader effect of changes in steel prices, the conclusions reached may be quite different from those reached by the Corporation. In fact, they would have to be very greatly different unless the further conclusion is to follow that private enterprise organized in the corporate system can only lead, if they follow the profit motive, to smaller and smaller output and more and more unemployment, and that the only way that increased production and fuller employment can be reached would be by substituting some other method of economic organization in place of the present right of corporate managers of industry to decide what prices to establish. It is not believed that either the steel companies or this committee would wish to reach that further conclusion.

Mr. WALTER WHITE. Isn't your conclusion in that respect dependent upon the nonexistence of competition to affect prices.

Dr. EZEKIEL. I am taking the statements made by the Steel Corporation for the industry in their presentation as representing the way that the industry operates. They discuss in their presentation the possibility of increasing prices or decreasing prices as if it lay within their power to make the choice quite without the effect of competition.

Mr. White. That is not my recollection of the testimony that Dr. Yntema gave. I don't think you were here, but that point came up. He was asked whether 50 percent in reduction in production and 50 percent increase in price would make more money for the Corporation and he said "yes." When asked why they didn't do it, he said competition in the industry, so I feel that is applicable to industry as a whole on that particular argument.

Dr. Ezekiel. I am sorry, I didn't hear Dr. Yntema's verbal discussion. I have read the various documents, particularly the document which compares the cost analysis with the price analysis, and as I read that document, it read in terms of "if this price policy were followed, such-and-such results would follow; if this price policy were followed, such and such results would follow," and included the statement which I quoted to the effect that it would never pay any industry like steel to reduce its price. As I pointed out, the same data just as readily lead to the opposite conclusion that it would always pay any industry like steel to raise its price. I haven't considered how many other industries are situated like steel, but have pointed out that if there were many, and all of them followed the principle that they could make the biggest profit by always raising price, it would be pretty hard on everybody else.

There is a third range of possibility which lies rather outside the scope of the material considered in the Steel Corporation's statement. Dr. Yntema, I believe, had just one passing reference to it; it was indicated in the third assumption that I stated in the beginning. Throughout their analysis the Corporation claimed that changes in steel prices have little or no effect on the demand of the final consumer for the products finally made from steel. That result follows, they claim, since the price of steel makes up such a relatively small fraction of the cost of finished automobiles, houses, tractors, locomotives, watches, and other products. It is rather interesting to note exactly that same argument, that the price of their product makes only a very small percent of the finished product, is made by lumber men in explaining why reduced lumber prices would not increase the sale of houses, by members of building unions in explaining why reduced per hour wage rates, for bricklayers and carpenters, would not increase the sale of houses, and by farmers in explaining why reduced wheat prices do not increase the sale of bread.

Dr. Kreps. Dr. Ezekiel, do you mean to say that we could use this same multiple correlation technic which Dr. Yntema has exploited to prove an inelastic demand for steel and establish by identical methods an inelastic demand for, let's say, a particular group of craftsmen of union labor in the steel industry?

Dr. Ezekiel. No; that is not my argument at this point. I am not referring to the technic of the statistical analysis here, but rather to the computation that since steel, say, makes only one-tenth of the cost of a finished automobile, if you reduce the price of steel 10 percent, you would reduce the automobile price only 1 percent, and that doesn't make any difference.

Dr. Kreps. Isn't that the identical argument of the plasterer when he says, "Why shouldn't I get $26 a day? It makes a difference of only a fraction of a percent in the cost of a house. There will be no stimulation of the demand for houses. People are not going to build any more houses if I take only $18."

Dr. Ezekiel. Exactly.

Dr. Kreps. Therefore, if labor argues that way, what do we call that type of reasoning? Is that the lump of labor fallacy, so-called?

Dr. Ezekiel. I am not trying to attach terms to these; I am just trying to point out the argument involved.

Dr. Kreps. Isn't it true that is called the lump of labor fallacy?

Dr. Ezekiel. Yes; it is in the case of labor.

Dr. Kreps. Therefore, when it is argued that general social policy should be based upon computations of this sort, actually you have a lump of business fallacy on advanced mathematical stilts.

Dr. Ezekiel. Yes; I guess you can call it that. I realize that as the steel industry is now organized, and as the activity legally permitted corporations of this country is now circumscribed, there is probably no way by which changes in steel prices can be coordinated with changes in other prices, although it might be interesting to point out in this connection that as far as I am aware, the anti-trust laws are solely directed against combinations in restraint of trade, and that so far as I know, there has never been a case to test whether combinations for the expansion of trade would be similarly illegal.

QUESTION OF CONCERTED ACTION TO EXPAND PRODUCTION

Dr. Ezekiel. But as business corporations do operate, it is no doubt true that there is no existing means by which reductions in steel prices could be brought about concurrently with reductions in cement prices, lumber prices, freight rates, automobile prices, furniture prices, houses, and perhaps even wage rates per hour, though not necessarily incomes per year of workers engaged in some of the more highly paid trades such as steam fitters, carpenters, and bricklayers. It is perfectly obvious that if some means could be found by which concerted reductions could be made in the prices of many products at the same time, the additions of these savings all down the line would add up to a very much greater reduction in price of the final finished product than would be possible if only a single industry made the change in price. So in periods of great economic contraction such as that which occurred in 1930 to '32, or again in late 1937 and '38, it should be possible for such concerted reductions in price to be accompanied by concerted expansions in output. The Steel Corporation itself has shown that such an increase from a low to a high output would greatly reduce the cost of output per ton produced.

There have been many discussions of the possibility of concerted action by industrial units which have seemed to assume that the only way that such concerted action could be brought about would be for the Government itself to take over the ownership of the industries, either through public ownership, to use the American term, or socialism, to use other terms, or else to assume that the only way that can be brought about would be for the Government to take over complete control of the production policy of a corporation through some such form as fascism. The argument made on this point has always seemed to lead to that conclusion—that either you would have socialism or fascism, either complete ownership or complete government regimentation in order to bring about any such considered action by industry. But it seems to me that there are other possible technics by which a democratic government can find ways to cooperate with industrial producers in assisting them to develop concerted programs

of production and price change which would not involve either of those extreme forms of economic organization. We do know that in agriculture the farms of this country are still owned by individual farmers, and we know that the programs of farm production are worked out democratically with the participation and approval of individual farmers, with a very great deal of planning from the bottom up through township committees, county committees, State committees, and regional committees so that the farm programs that are in effect are not programs imposed from Washington, but are programs worked out from grass roots up, representing the decision of farmers as to what they feel needs to be done after they go over the fact.

Yet at the same time through these programs the producers of the major export crops working through the A. A. A. and associated programs have found a means of taking concerted action with respect to the acreage and price of their major crops without involving either socialism or fascism. So the fact that it has been possible to work out democratic procedures and carry through concerted action in the field of agriculture may suggest that parallel democratic procedures could be developed in the field of industry, and that through those democratic procedures, production might be increased, prices might be reduced, and employment raised on a larger scale than individual industries have been able to establish and maintain during recent years.

Mr. Hinrichs. Pardon me, but have I misunderstood what has happened under A. A. A? Was the procedure one which reduced prices and increased production, or was it merely the fact that discussions had taken place democratically, in which you are suggesting the parallel?

Dr. Ezekiel. No; it is obvious that A. A. A. has not been aimed at the further expansion of agricultural production in the face of the very low market for farm products which have resulted from a low industrial production. I am bringing the A. A. A. experience into evidence merely to show that it is possible to bring producers together on concerted programs of action, and that those concerted programs of action can be devised through democratic procedures.

Mr. Wooden. Dr. Ezekiel, do you think that method of procedure is applicable and practical in the case of an industry where you have 9 or 10 concerns controlling 80 percent of the output?

Dr. Ezekiel. Yes. I believe it would be infinitely easier to sit down around a table with 8 or 10 men and work out what each industry should do than to go out into the field to develop an agricultural program by discussing it with two or three million cotton producers or one million wheat producers, and get those several million producers to take concerted action.

Mr. Wooden. It would be decidedly easier to get concerted action?

Dr. Ezekiel. Yes. It should be easier in industry. If you did get concerted action among each of the great industries, each of them expanding its production in the proper proportion, then you would have larger markets and you would have a material reduction in the final price which would make it possible to move the products into consumption.

Mr. Wooden. Was not cooperation among the farmers for the purposes of decreasing production and increasing price?

Dr. Ezekiel. Yes, sir; that is what Mr. Hinrichs has just pointed out.

Mr. Wooden. You would favor that in the case of all industries?

Dr. Ezekiel. No. As matters now stand, if a single industry takes concerted action to decide what it should do, whether that single industry be agriculture or whether it be the petroleum industry or the anthracite coal industry or the bituminous coal industry, operating as a single industry, the thing it is most likely to do is to say, "The market for our product is only so much; national activity is so much, and this limits the market for our product. Therefore, we as a single industry, must be careful not to produce too much for our market." That, of course, is what the steel industry has done in the past, when it has so greatly cut down its production.

What I am proposing, however, is that a number of the great industries, each at the same time, expand their production so that their total market will not be determined by the present relatively low production and national income of the whole country, but will be determined by the much larger production and national income which they are all proceeding to create. One industry by itself cannot expand national production as effectively as can many industries working together. Only concerted action taken among many great industries at the same time can, by that action, make a bigger market for the product.

Mr. Hinrichs. Pardon me, but you said one industry cannot expand national production, and a little earlier we had one industry that was expanding national production. You mean that one industry, acting by itself, cannot expand national activity to a sufficiently large extent to benefit or to be certain of benefiting financially from that expansion in national activity? You don't mean to go back on your earlier statement that that 3 percent expansion on a 10 percent reduction price is going to have in and of itself some beneficial effect on the rest of the economy, though it might be bad for the stockholders of the Steel Corporation?

Dr. Ezekiel. Yes. My statement should be that one industry by itself cannot produce anything like as much effect on national income as can concerted action by many industries. You are quite correct:

And now, the testimony that the Steel Corporation has put in, that it would never pay them to reduce prices, suggests that private corporations, if they continue to operate in the next few years with the same philosophy as that which has controlled their operations in recent years, will never find ways to solve the large and continuing unemployment. And yet, if private enterprise is to survive, business must find a way under private enterprise to solve the problem of unemployment and to provide a continuing rise in the standard of living—more goods to consume for each day's work.

Now, in concluding this statement, I would like to indicate that I am quite aware of the fact that no way has yet been developed and put into action by which the officers of the Steel Corporation or any of the great corporations similarly situated could take such concerted action to reduce prices and increase production in many industries concurrently as that which has just been suggested above, and I would also like to indicate that the problem is a much larger one than the problem of prices and production alone, because expansion

in production and in consumption and employment can be continued and maintained only if the buying power that is made available to the workers of the country is increased rapidly enough so that the consumer demand for the various products produced rises in proper proportion to what is being produced. In other words, if you increase production and don't give your consumers, the people of the country, enough income to buy the output, you cannot maintain increased output.

On the other hand, if you do increase buying power in proportion to the increased output, then that will call into action still further increases in production and further expansions in plant capacity.

The problem of devising a program of concerted industrial expansion so as to secure a proper proportioning of the changes in prices, wages, production, employment, investment, and expansion in plant and equipment, is much more intricate and extensive than can appropriately be discussed at this point. However, as I understand the job which the Temporary National Economic Committee is attacking, it is to suggest ways by which the productive facilities of this country can be used to the fullest extent so as to secure a steadily rising standard of living and so as to insure that the steady increase in technological efficiency and in industrial arts and sciences shall produce hereafter a steadily rising level of consumption for all our citizens, instead of producing, as they have so often up to this time, a steadily increasing proportion of our citizens who are barred from normal participation in society.

While the Steel Corporation alone is not in a position to bring about such modifications in laws and methods of business organization as might lead toward this result, the T. N. E. C. is in a position to consider such changes. It is for that reason that I have presented this final discussion of ways in which concerted price reductions might bring about higher profits and higher employment even if individual corporations such as the Steel Corporation, are not now in a position to undertake such concerted operations.

Acting Chairman O'CONNELL. Are there any questions?

Mr. HINRICHS. I have two further questions. You speak of concerted action to achieve price reductions. I suppose you are distinguishing there between concerted action and simultaneous action. It is conceivable that under conditions of competition between small producing units, it would not require willful action of any significant extent to reduce prices. Industrial producers would find themselves in much the same position that farmers find themselves in. Prices of farm products, as I understand it, have gone down more or less simultaneously, not because of any concerted action by farm producers, but because of the effect of competition against large producing capacity in periods when national income goes down. Is that not correct?

Dr. EZEKIEL. Yes; that is quite correct; but if all of our industries were organized on as competitive a basis as most farm production is organized, or was organized prior to A. A. A., and for that matter, as competitive as most cotton textile producers are organized and many dress goods producers, then when people are unemployed, when demand is low, competition would force prices to fall together, and you would get as a result of competition, an expansion in employment and expansion in production. But as our economy is organized today,

not only steel but many other great industries, seem to be so organized that prices do not fall when demand goes down, or at least, prices do not fall anything like as rapidly as they do in other industries. Instead, output is reduced as demand falls.

Mr. HINRICHS. That is, your prices under competitive conditions, willy-nilly would normally fall to something approximating the variable costs of the marginal producer; that is, if we were to assume that these variable costs of $55 a ton represented marginal costs, irrespective of whether or not it is a good thing for the owners of a particular business, you would expect large amounts of unused capacity to drive prices down to something approximately close to that $55 level. Is that correct?

Dr. EZEKIEL. Yes; we had it in agriculture. Prices fell far below the level that covered the computed cost of all the costs involved in the business, but farmers produced and sold in spite of that because there wasn't anything else they could do under competition.

Mr. HINRICHS. Now, the corollary of what you have been saying with reference to concerted action to reduce prices and expand production, if I understand you correctly, is that any concerted action to maintain prices, while it may be beneficial to the particular industry involved, is by just that extent deleterious to all of the rest of the economy. All the other units that are also dependent upon the total volume of national income and industrial activity suffer from the curtailment that is involved in the maintenance of high prices. Is that correct?

Dr. EZEKIEL. Yes; that is correct and is borne out by the experience of the last depression. During the last depression, beginning in 1929, each of these industries that have only limited competition sought to restrict their output so as to maintain their price, but each of them suffered from the fact that many other industries were doing the same thing. As a result, demand as a whole was collapsing, and even with restricted output, these industries still had difficulty maintaining price.

I would like to go back to a couple of the other points you made earlier, just to clear up the issues raised. You were quite correct that I used the term "concerted action" as opposed to "simultaneous action." Many of these industries do have such a concentration of corporate control, have production in the hands of such a small number of producers, that anything like free competition just cannot take place. The only way they can take action of the sort I have described is if they definitely plan it, if they definitely get together and arrange, both in each controlled industry and between the different industries, to move together on a program to reduce price and increase production.

May I make one more point on this question that Dr. Hinrichs raised? You asked if the fall in price in competitive industries would not tend to produce that result—increased production—automatically. In that connection it is interesting to contrast what happened to the steel industry itself after the very high prices of the immediate post-war period, in 1919 and 1920, and after the prices of 1929.

After the war-inflation boom, when demand fell off in 1921 and 1922, there was apparently much more competition in steel then than there is now, because steel prices did come down very, very rapidly. Other prices came down even more rapidly. The decline in nominal steel

prices from the high in 1919 to the low in 1921 was as great as in all commodities, but the decline in actual mill net yield was not so great, according to the data filed by the United States Steel Corporation.

The depression of 1921–22 was over very promptly, at least compared to this past depression. After the war boom, the post-war depression involved a rapid drop in price of almost all industrial products, and brought about a prompt increase in production and increase in employment, so that by 1923, new high levels were being made in production. But during the depression of 1929, industrial prices did not fall as greatly, and instead of having a short depression, even though a hard one, with a prompt recovery, the recovery didn't come and didn't come, and still has not come in full measure.

Mr. WOODEN. If, as you say, it is impractical to expect competition in an industry such as steel, and if no one of the 9 or 10 producers who control collectively some 80 percent of the output will reduce prices as a matter of competition, what reason is there to expect that they will do it if they are permitted to take concerted action?

Dr. EZEKIEL. Well, I haven't suggested that merely by permitting them to take concerted action, it would necessarily result in their doing so. In fact, I was discussing not merely concerted action in the steel industry, but concerted action in a number of great industries at the same time, in the steel industry and the automobile industry and the cement industry and the glass industry and in a number of other industries.

Mr. WOODEN. Under some form of Government control, you mean?

Dr. EZEKIEL. Under some form of Government participation, sufficiently to insure that the action taken by industry would be in the general welfare. I have discussed elsewhere various forms of organization that might be used to bring about that result.

Dr. KREPS. Dr. Ezekiel, are you familiar with the proposals of Prof. O. M. W. Sprague of Harvard University in this regard?

Dr. EZEKIEL. I have a general acquaintance with them. I am not sure that I can expound them in full.

Dr. KREPS. As you understand his proposals, does he recommend that in the building field there be some such, as you have said, concerted action or simultaneous action, in order to reduce costs of housing?

Dr. EZEKIEL. Yes; I believe that he pointed out that if you really wanted to get housing costs down, you had to get reductions all along the line, and that if you get reductions by all the persons who participated in the housing, you could expect to get such an increase in houses sold as to bring about a benefit for all involved.

Dr. KREPS. And as I understand your point it is the pertinent consideration, if we want to increase the volume of housing. If we took each particular commodity, we could show that in each particular case that a reduction in price would have a negligible effect on the total volume of housing; isn't that correct?

Dr. EZEKIEL. Yes; I believe that is correct for housing.

Dr. KREPS. We could prove it for each individual, particular case, and yet when we added it up, our results, instead of being a sum total of the individual effects, would be according to Dr. Sprague and according to your analysis, diametrically opposite. The social effect, in other words, is entirely different from the sum total of individual effects. The results of particular studies, of each of the materials that

goes into a house and each of the skilled groups of labor, do not give us a guide for public policy with respect to housing; is that correct?

Dr. EZEKIEL. Well——

Dr. KREPS (interposing). It is the total picture that you regard as important?

Dr. EZEKIEL. Yes; studying any one part of it does not necessarily tell what the possibilities are if the problem is dealt with as a whole.

Acting Chairman O'CONNELL. Are there any other questions? Have you any other questions you would like to ask, Dr. Kreps?

Dr. KREPS. No, you may dismiss the witness.

Acting Chairman O'CONNELL. Thank you very much, Doctor. I think that is all.

Dr. KREPS. I would now like to summon Mr. Martin Taitel to the stand.

Acting Chairman O'CONNELL. Have you been sworn yet?

Mr. TAITEL. No; I have not.

Acting Chairman O'CONNELL. Do you solemnly swear that the testimony which you are about to give in this proceeding shall be the truth, the whole truth and nothing but the truth, so help you God?

Mr. TAITEL. I do.

TESTIMONY OF MARTIN TAITEL, SENIOR CONSULTING ECONOMIST, WORK PROJECTS ADMINISTRATION, WASHINGTON, D. C.

Dr. KREPS. For the purpose of the record, Mr. Taitel, will you state your full name and address?

Mr. TAITEL. Martin Taitel.

Dr. KREPS. And your address?

Mr. TAITEL. Chevy Chase, Md.

Dr. KREPS. You have been formerly with the N. R. A. as economic adviser on codes and statistician?

Mr. TAITEL. Yes.

Dr. KREPS. Where did you receive the bulk of your training in statistics?

Mr. TAITEL. Under Professor Yntema at the University of Chicago. I should like to say that I am very proud to have received my training from Professor Yntema; I hope he will be as proud of the product of his training.

Dr. KREPS. You have prepared a statement for us. Is it the one to which we heard something of a rebuttal this morning?

Mr. TAITEL. I should say a rebuttal in part.

Dr. KREPS. You may proceed.

Mr. TAITEL. The steel industry has rather generally been regarded as an industry with high "fixed" costs, that is, one of these industries in which unit costs of production decline as output increases.

So far as prices in such an industry are based upon costs, the pricing policy would tend to be one that provides for declining prices as the volume of output increases. Prices in the steel industry, however, have not followed this pattern. They have tended to remain relatively fixed. The typical practice has been to increase prices with increased volume rather than to decrease prices as sales expand. Such price behavior is much more consistent with a situation in which increasing output is associated with constant or rising costs.

UNITED STATES STEEL CORPORATION ANALYSIS OF COSTS IN RELATION TO PRICE DECISION-MAKING

Mr. TAITEL. The statistical analysis of costs presented to this committee by the United States Steel Corporation is designed to defend the pricing system practiced by the Steel Corporation. It is designed to show that the price policy actually pursued by the corporation has been in considerable measure dictated by its costs. The illusion is created in the analysis prepared by the Corporation that the great bulk of the Corporation's costs vary directly with the number of tons of steel it produces. This illusion has been attained by dissolving the distinction between fixed and variable costs. All costs, except bond interest and pensions, are treated as if they were made up of fixed and variable elements which can be segregated by means of highly refined statistical techniques, but cannot be segregated on the basis of direct observation. The net result of such manipulation is the one obtained by the Corporation, namely, costs are in the main shown to be "variable" costs. But, unless one accepts the highly sophistical theories upon which the numerical calculations are based, one cannot accept the Corporation's analysis as a true reflection of the cost situation in the steel industry as a basis for price policy.

Any cost accountant or statistician working with cost figures can attain a variety of cost-volume relations by varying the methods of computing or stating costs. This is strikingly illustrated by the sharply contrasting results obtained by the "Iron Age" and the United States Steel Corporation. Mr. T. W. Lippert, metallurgical editor of "Iron Age", presents, in this year's January 4 issue of that journal, a production-profit curve based upon his examination of "production-profit data of two large steel companies—both integrated producers and both makers of practically all types of steel, from fine wire to structural shapes and including low alloy steels." The results presented differ from the comparable results of the Corporation's analysis.

I should like, Mr. Chairman, at this point, to offer for the record a chart entitled, "Contrast in Production-Profit Computations."

Dr. KREPS. Will you display the chart, please?

Acting Chairman O'CONNELL. It may be admitted.

(The chart referred to was marked "Exhibit No. 2184" and is included in the appendix on p. 14120.)

Mr. TAITEL. The Corporation's analysis purports to show that profits vary directly with output; namely, the addition to profit is the same for each additional ton of steel sold.

Mr. Lippert's analysis, on the other hand, purports to show that the relation between profits and production is decidedly not of this direct character but that changes in output produce profits of varying magnitudes, depending upon the rate of capacity at which plants are operated. According to his analysis, the rate of profit per additional ton of output increases rapidly between the break-even point—roughly 45 percent of capacity—and about 80 percent of capacity. Above the 80-percent level there is only a very small profit per additional ton of output until a rate of capacity somewhere around the 90-percent level is reached, after which a loss is associated with each additional ton to full capacity. Furthermore, according to Mr. Lippert's study, below the break-even point losses increase very

slowly as operations are reduced to about 20 percent of capacity and then increase sharply as the operating rate approaches zero.

Dr. KREPS. Mr. Taitel, will you turn to the chart and indicate the significance of what you have just testified?

Mr. TAITEL. This is Mr. Lippert's curve and he shows that from the break-even point——

Dr. KREPS (interposing). Just a second. That is Mr. Lippert's curve reproduced from the January 4 issue of "Iron Age" of this year?

Mr. TAITEL. Yes.

Dr. KREPS. Do you know who Mr. Lippert is?

Mr. TAITEL. He is the metallurgical editor of "Iron Age."

Profits from the break-even point—these are total profits—increase much more sharply than output. The increase in slope of this curve as it goes above the break-even point indicates that the additional profit per ton increases with an increase in the percent of capacity operating.

Dr. KREPS. How does that contrast with the lower chart, which is based, I take it, upon the materials that have been adduced by the Steel Corporation?

Mr. TAITEL. The lower chart represents a situation in which the profit per additional ton is constant. As I have plotted it here, I believe for each additional ton, the addition to profit is about $18.

Under Mr. Lippert's computations, losses do not increase very rapidly as operations decline below the break-even point.

Dr. KREPS. Of what significance is that fact?

Mr. TAITEL. According to Mr. Lippert's computations, steel plants are able to operate between 20 and 45 percent of capacity without much change in the total loss; within that range of output there is very little change in the loss, assuming, of course, no change in prices.

Dr. KREPS. You mean if the top curve is true to fact, I take it. Is that right?

Mr. TAITEL. Yes. I should perhaps note that in both cases the price structure is assumed to be the same, so that receipts would increase directly with output.

Dr. KREPS. Supposing you had a 10-percent reduction in price, does it make any difference whether the condition of the industry is that as represented in the top chart as compared with that in the bottom chart?

Mr. TAITEL. It makes a good deal of difference. Speaking in approximate general terms, a 10-percent reduction in price would bear less heavily on profits assuming Mr. Lippert's curve is correct when operations are above the break-even point but below about 80 percent of capacity. The reverse is true below the break-even point but above about 20 percent of capacity.[1]

Dr. KREPS. If you were to take those rather startling loss figures of Dr. Yntema—those estimated loss figures guessed at but precisely stated in dollar figures, thus giving them a specious and spurious plausibility and reminding one of the cynic's definition of statistics as the science that states an uncertainty with precision—how would

[1] In precise terms, the adverse effect upon profits of a price reduction when output is at a given level is greater for the production-profit curve with the lesser slope between that output level and the new level of output. Since, however, the scales for the two curves are not the same—Mr. Lippert providing no indications of absolute amounts of profits or losses—it is not possible to state exactly the ranges of output for which the adverse effect is greater or less for one curve than for the other.

those estimated losses be changed if the cost curve in the industry corresponds to the pattern of profits shown in the upper part of your chart ("Exhibit No. 2184") as contrasted with that shown in the lower portion of your chart?

Mr. TAITEL. I am not sure that I understand the question.

Dr. KREPS. I will repeat the question in a different form. Would the estimated loss from a reduction in the price of steel be less or greater if the condition that Mr. Lippert describes is true, than it was represented to be on the charts that Mr. Yntema showed?

Mr. TAITEL. The adverse effect upon profits resulting from reductions in price would be less in the case of Mr. Lippert's curve when operations are approximately between the break-even point and 80 percent.

Mr. WALTER WHITE. Do you know what statistics and figures Mr. Lippert had available from which he derived his curve?

Mr. TAITEL. He says he used production and profit data for two large steel companies. I have not seen the detailed figures. I have simply reproduced the chart as it appears in "Iron Age."

Mr. WALTER WHITE. Does it show that a decline in profits occurs after a certain volume has been passed?

Mr. TAITEL. That is correct. Beyond about 90 percent, total profits decline, that is, for each additional ton to expand from about 90 to 100 percent there is a loss.

Mr. WALTER WHITE. Is that because it is in an inefficient plant, do you know?

Mr. TAITEL. He states that it is due to general inefficiencies—trying to meet particular orders of particular customers at particular times, bringing in of obsolete capacity, and so on.

Mr. WOODEN. Is it to be understood that the United States Steel Corporation is not one of the two that are included in Mr. Lippert's study?

Mr. TAITEL. There is no statement to that effect in Mr. Lippert's article. He does not state the names of the two companies. I think, though, that this chart expresses more eloquently than any words at my command the different results which can be obtained from studies of cost records in the steel industry.

My analysis of the Corporation's cost analysis is directed toward this point: The arbitrary nature of the allocation of costs as between years or over portions of the output makes it impossible for particular cost-volume computations such as the Corporation has presented to be the all-important basis of decisions as to prices. The conclusion is not that the Corporation does not have to reckon with its money costs. Rather, the conclusion is that the kind of cost-volume relation which the Corporation derives is not the one relevant to price decision-making under actual operating circumstances.

To establish my main conclusion, it is necessary to establish two others. First, that the Corporation in particular, and almost any business firm in general, has a choice as to *when* and in what amount it will charge a considerable number of items of expenditure to costs. And, second, that the cost-volume relation obtained by the Corporation's analysts is in large part the consequence of the particular times at which it has chosen to charge certain expenditures to costs, and of the particular accounting procedures by which it has chosen to be governed in allocating costs.

I want to make very clear the fact that I am questioning neither the validity nor the usefulness of the accounting procedures or records of the Corporation, nor the statistical methods or procedures used by the Corporation's analysts when they are directed toward purposes other than the one now under discussion. In fact, I, as one who pretends to be qualified, want to pay tribute publicly to the skillful and ingenious use which has been made of highly refined and advanced statistical techniques. I must, however, point out that even the most ingenious and advanced methods of accounting and statistical analysis may not provide the correct answer to the particular issue to which they are addressed.

The essential requirement of a costing system is that it shall be useful in terms of particular purposes. Thus, in a book written by three eminent authorities—Professors Sanders, Hatfield and Moore—published by the American Institute of Accountants in 1938, and sponsored by the Haskins and Sells Foundation, there appears the following statement:

> Since the income statement is prepared for the information of owners, managers, creditors, and taxing authorities, and for regulatory and other purposes, those accounting practices are best which serve these purposes in the most reliable and helpful manner.
>
> It sometimes becomes necessary to prepare separate statements to serve the several purposes.

An eminent economist—Prof. J. M. Clark—in his classic study, "The Economics of Overhead Costs", published in 1923, points out—

> * * * the cost-accounting conceptions of cost do not agree with cost as used by the general accountant, and they disagree because they are wanted for different purposes.

Typically—and I believe this is true of the Corporation—the costing system is designed to be useful for operating, tax or public-statement purposes. That such a system should, without any recasting of accounts, provide data showing the "actual" or "true" division between fixed and variable costs or the "actual" or "true" shape of the marginal cost curve is not to be expected. Consequently, since costs as entered on the books are for general purposes, a cost analysis based upon book costing contains no inherent validity.

Allocation of costs as between years or as between segments of output is and must be in part arbitrary no matter what accounting principles and practices are followed. Many items of cost have no observable economic or physical connection to the output with which they are associated. While practical considerations require their allocation, the guides themselves are not sufficient. Within wide limits set by custom, allocations are molded to show particular results for the particular purposes of the allocater.

In making the allocations the overpowering tendency is to use accounting procedures which will place costs on the books when there is output and receipts against which to charge them. A variety of reasons on the part of management may explain this—reluctance to adopt accounting methods which might show large losses in poor years, efforts to minimize tax liabilities, desire to allocate building and equipment expenses as equally as possible over all units of output, and so forth. Taken together, these underlying motives operate (*a*) to minimize the fixed costs, (*b*) to raise the variable costs, and, (*c*)

to show constant marginal costs, when comparisons between book cost and output are made. Thus, the true picture is distorted.

There is another tendency underlying ordinary costing which leads in the same direction. Some choice as to timing exists for certain types of expenditures. The tendency is to vary such expenditures with the volume of receipts. At the same time, there is the tendency to charge them to current operations, to consider them sunk costs, the sooner off the books the better.

The effect of the particular accounting procedures used upon the results obtained from a study of over-all cost-volume such as the Corporation's is so great that it cannot be neglected. In fact, it may be said that the accounting procedures themselves are major determinants of the statistico-arithmetic results. Particular consideration must be given to the allocations of charges as between years since it is the shape of the cost curve which expresses whether unit costs increase, decrease, or remain constant with increases in output. While (*a*) the items included in cost and (*b*) the total amounts of those items charged to costs over the life of the business are also factors, yet they do not loom large in comparison with the allocation of the items included as between years, particularly in an analysis such as the Corporation's in which practically all expenditures are included. I shall not discuss these two elements; partly because they do not appear important, but also because the published sources provide no adequate material for determining their effect upon the cost-volume analysis.

The chief items subject to allocation over accounting periods are depreciation, depletion, amortization, maintenance, repairs, intangibles such as patents, and similar items. Clearly when such expenditures are actually charged to costs is just as important as how much is charged to costs. That the Corporation has in the past made serious errors in the timing of the charges is indicated by the establishment in 1935 of a "Reserve for amortization of investments in subsidiaries" of 181 million dollars. This reserve was established, presumably, because of the undercharging of depreciation in the period prior to 1935. In 1935 and later years the reserve is drawn upon to increase current profit figures—about $7,000,000 in 1936 and $8,000,000 in 1937. Thus, when "costs" are shifted as between years the results of a cost-volume analysis are different from those which might have been obtained had such shifting not been indulged in.

The periods to which expenditures are charged as costs are sometimes the result of advanced planning, such planning being based upon the estimated life of assets, the estimated output or both. Errors in such estimates are corrected by adjustment on the books as they are recognized. Final adjustment always occurs at the time of disposal of the assets. For it is only upon final liquidation that actual costs are known. Business, however, must make interim estimates; hence the errors.

The method of handling such adjustments is, however, extremely important if the figures are to be used for an analysis of costs. Typically, a revision of cost figures for prior years is not made by revising the figures for the earlier years but by adjusting the figures for the current year. This may not be a serious matter if the adjustment is not included as an item of current costs but as an adjustment to surplus. But, if the adjustment is charged to current costs (or spread

over current and future costs), any cost-volume analysis based on them will be seriously warped.

The Corporation's method of handling one type of adjustment is indicated in the annual report for 1928, which states that—

> The large increase in the provisional allowances by subsidiary companies in 1928, compared with 1927, is attributable to a considerable extent to the rather substantial amounts charged off for obsolescence of property investment cost in connection with abandonment of old plants not theretofore fully depreciated.

Thus, what might be construed as an adjustment for inadequate depreciation prior to 1928 became an operating charge in 1928.

An interesting discussion of the extent to which the United States Steel Corporation erred in computing profits and, therefore, costs during the twenties is contained in a paper by W. A. Hosmer, in "Business and Modern Society", published by the Harvard University Press in 1938. I refer those who are interested in further study of the matter to Professor Hosmer's very excellent paper.

In the ultimate analysis, because of the discretionary elements of all cost allocation, everything that may be shown by the cost-volume relation is explicitly or implicitly assumed by the accounting procedures as appropriate. It is impossible to demonstrate that any particular allocation is most valid except for a particular purpose. All that we can show is that a particular method of allocation gives a particular relation between charges to costs and volume. This is what the Corporation's analysis shows at most, for example, for depreciation and depletion.

The sources upon which my analysis is based are (1) the Corporation's study entitled, "An Analysis of Steel Prices, Volume and Cost," I believe identified as "Exhibit No. 1416,"[1] (2) the Corporation's annual reports, and (3) the Corporation's registration statement filed with the Securities and Exchange Commission. I am convinced, however, that the essential nature of my conclusions would not be changed had I had access to the sources at the disposal of the Corporation's analysts.

In order to bring out most clearly the full effect of the arbitrary nature of cost allocation and classification, I have cast my analysis within the same general statistical framework as that used by the Corporation. In so doing, I do not imply that that framework is above criticism. In this connection, the following observations are, I think, pertinent.

1. I have used the Corporation's own measurements of output, i. e., the Corporation's own figures on weighted tons of products shipped, though I do not admit the validity of the methods used to devise them. The principal defects of these measurements for purposes of cost analysis revolve around the weights used to convert quantities of a wide variety of different products into homogeneous units of output and the lack of consideration given to changes in capacity during the period covered.

2. Though I do not admit the validity of the particular application, I have used the least squares or correlation technique, though perhaps not with the same degree of excellence as the Corporation's analysts, for deriving the summary relation between a cost category and volume, and have labeled the statistical results (technically esti-

[1] Appendix, p. 14032.

mates of parameters) as "fixed" and "variable" costs in the same manner as has the Corporation. The principal defect of the technique is that it takes no account of the interdependence of the cost measurements for the various years. This defect is extremely critical. Because it exists in the technique, no account is taken of such facts as this: If depreciation is charged to costs in one year, it cannot be charged in another year so that relatively high charges in one year tend to involve relatively low charges in another year.

3. I have not attempted to measure the effects of such inadequacies as may exist in the Corporation's adjustments of pay-roll and "other expenses" to "1938 conditions." The pay-roll adjustment as made takes no direct account of the possible effects upon average hourly wage rates of differences in the proportions of employees in the various occupations at different outputs. Furthermore, the facts upon which the adjustment for increasing labor efficiency was made seem more appropriately to indicate (*a*) declining unit labor cost with the expansion in output during 1927–29 and 1934–37, and (*b*) inadequate allowance for changing compositions of the working force during 1930–33. With regard to "other expenses" it seems pertinent at least to raise the question as to whether a somewhat modified general index of prices is appropriate for deflating the amounts paid by the Corporation for what must be a rather specific composition of goods and services.

That the purpose for which accounting statements are made determines, in part, the way in which expenditures and charges are classified can be illustrated by contrasting the segregation of accounts for public statement purposes with the segregation of accounts for the cost analysis.

I have six tables. Shall I insert them one by one?

Dr. KREPS. Would you prefer to insert them as a group at this time?

Mr. TAITEL. I believe that would be most convenient.

Dr. KREPS. Mr. Chairman, I should like to insert into the record a series of six tables titled as follows: Table I, "Reconciliation of Total Costs Before Bond Interest and Inter-Company Items in 'Analysis' and Registration Statement, 1935–37"; Table II, "Comparison of Break-Down of Lumped Costs in the 'Analysis' and in Registration Statement, 1935–37"; Table II–A, "Additions to Reserves Charged to Cost of Goods Sold, Etc., 1935–37"; Table III, ' Taxes Other Than Federal Income and Social Security Taxes, 1927–38"; Table IV, "Taxes Other Than Federal Income and Social Security Taxes, 1927–38—Recomputed 'Fixed' and 'Variable' Costs"; Table V, "Maintenance and Repairs, 1927–38"; Table VI, Stripping and Development Expenses, 1927–38".

Acting Chairman O'CONNELL. Who prepared these charts?

Mr. TAITEL. I prepared these tables.

Acting Chairman O'CONNELL. And the source of the material?

Mr. TAITEL. The sources are indicated on the table. They have been taken from the three general sources I indicated, the Cost Volume Analysis, the annual reports, and the registration statement.

Acting Chairman O'CONNELL. They will be admitted.

(The tables referred to were marked "Exhibit No. 2185" and are included in the appendix on p. 14121.)

Mr. TAITEL. A reconciliation of the figures in the Corporation's "Analysis" with those in the S. E. C. registration statement for the three years 1935–37 is shown in Table I of the group of tables identified as "Exhibit No. 2185." To obtain the same total costs, (1) "Expenses for dismantling, moving, and rearranging of existing facilities, less the value of salvage recovered in connection therewith" have to be omitted although classified as operating expenses in the registration statement; (2) "Plant and organization survey expenses" have to be included although classified as an income deduction in the registration statement; and (3) "Discount on purchases" has to be included although classified as other income in the registration statement and annual reports.

In the annual reports and registration statement there is a functional classification of accounts. Cost of goods sold, and so forth (including intercompany items), apparently includes all items which are construed to be allocable to specific items of output. Thus, certain amortization, rents and royalties, and maintenance and repairs, are charged directly to cost of goods sold. At times, also, certain taxes (in minor amounts) have been so charged. Included also, are gross operating expenditures for transportation and miscellaneous operations (both shown separately at times).

Another general functional category is "Other operating expenses" which apparently covers items which are not deemed to be specifically allocable to items of output. Presumably, only steel operations are covered. The major items are (1) general administrative and selling expenses, (2) depreciation and depletion, and (3) taxes.

Finally, there is a third functional classification—"other income" and "income deductions." This includes items apparently considered to be nonoperating in character, such as dividends, rents and royalties, capital losses, and so forth.

In the Corporation's cost analysis the classification of accounts used for public statement purposes is retained only in part. The bulk of the costs are redistributed into two classifications: (1) Pay roll, and (2) other expenses. It was not possible for me to recast them along functional lines since the Corporation's public statements do not contain the necessary data. It was possible, however, to indicate the character of some of the items included in the two categories. This is shown in Tables II and II–A[1] where the two types of breakdowns are compared.

The two bases of classification are not contradictory; they are just different. And the reason they are different lies largely in the different purposes for which the Corporation has prepared them.

That the Corporation has made an inadequate division between fixed and variable costs, even in terms of its own analysis, is clearly illustrated by the treatment accorded in the cost analysis to taxes other than Federal income and social security taxes. This tax item includes mainly State and local property taxes but also the Federal capital stock and excise and miscellaneous taxes. The break-down is shown in Table III of "Exhibit No. 2185." For some years the tax figures apparently represent the accrual of tax liabilities and the difference column indicates the extent of allocation as between years.

Capital stock taxes should not have been lumped with the other taxes. The Corporation was not subject to such taxes prior to 1932.

[1] Of "Exhibit No. 2185," appendix, pp. 14121 and 14122.

so that they should at least have been segregated. But most important is the fact that capital stock taxes under "1938 conditions" depend, not upon output, but upon decisions by management based upon estimates not only of future costs but also of future output and prices. Stated otherwise, declared values for tax purposes are determined within limits by management forecasts of net incomes, i. e., the estimated relation between costs and receipts; they are not determinants of net incomes in the sense in which a property tax is. Thus, reduction to "1938 conditions" for purposes of a cost analysis implies that the 1938 figure should best be used for all years, i. e., that the capital stock tax is probably best considered as a fixed cost. The contention might be made (and to some extent is implicit in the Corporation's analysis) that declared values would vary with output. But this assumes that prices will vary with output in such a way as to make it profitable for the Corporation to vary the declared values with output. Realistically, such an assumption, not to mention the assumption of accurate forecasting, has no place in a cost analysis, particularly one for the Corporation in view of the fact that in 1938 a greater tax was allocated to costs than in 1937.

Appropriate treatment of the capital-stock tax would destroy what little reliability there is in the analysis of taxes on pages 13–14 of the Corporation's analysis.

Dr. KREPS. What exhibit?

Mr. TAITEL. "Exhibit No. 1416." They account for a good share of the rise in taxes between 1932 and 1938 as the figures in Table IV of "Exhibit No. 2185" show. Exclusive of capital stock taxes there is no significant difference between the relation of taxes and weighted tons for 1932–38 and the relation for 1927–31. The $43,200,000 item for 1937 is the most extreme observation, being about 15 percent above the next largest one. This suggests not a shift in the tax burden between the two periods, but rather some peculiarity in the 1937 tax charges.

The effect of using tax figures appropriate for general-statement purposes, but not appropriate for cost-volume relations, upon the results of the Corporation's analysis is substantial. Results of a recomputation of the tax regression both including and excluding 1937 data are shown in Table IV of "Exhibit No. 2185." Capital-stock taxes have been considered as a fixed cost at the 1938 level.

Both of the recomputations show a much higher "fixed" and a much lower "variable" tax cost than is shown by the Corporation's analysis. Even with the 1937 observation included, "fixed" costs are raised by almost 25 percent and "variable" costs lowered by over 50 percent with reference to the results of the Corporation's analysis. The recomputation excluding 1937 shows "fixed" costs to be raised almost 30 percent and "variable" costs lowered almost 65 percent.

A study of the maintenance and repair expenditures of the Corporation shown in Table V of "Exhibit No. 2185" illustrates the tendency of the Corporation to charge some expenditures to costs when made. It also provides another illustration of the effects of an inadequate segregation of costs upon the results of a statistical cost analysis. In this latter case it is the Corporation's treatment of maintenance on railroad properties which may be suitable for some purposes of the Corporation but which is definitely misleading for purposes of cost analysis.

The bulk of the maintenance and repair expenditures (all in the case of railroad properties) are charged to costs as made, although small portions are passed through reserves each year. By and large, however, maintenance is charged as the work is done—not when the particular outputs making maintenance necessary occurred. Furthermore, no segregation appears in the published sources (except to a very limited extent in the registration statement) between maintenance required regardless of output and the additional amounts of maintenance required for each level of output. And in the cost analysis, maintenance is presumably buried in pay-roll and other expenses—although the figures are available—even though the amounts charged to costs in some years have been almost twice as great as depreciation and depletion.

Included in the maintenance and repair accounts of the Corporation are the expenditures on its railroad properties which are always charged to costs when made. But all of the operating and maintenance expenses of its railroads should not be included in those costs which are presumably comparable with steel shipments. (For a wider range of factors this point is discussed and carefully minimized in the Corporation's analysis, pp. 39–42, "Exhibit No. 1416.") Part of the other transportation and miscellaneous operations should also be excluded. But it was not possible to do so since the necessary accounts are not shown separately in the annual reports. However, other than railroad maintenance charges are relatively minor items—they only accounted for about 3 percent of the total maintenance expenditures in 1929, whereas railroad transportation accounted for about 20 percent.

The allocation of practically all maintenance and repair expenditures to costs in the year in which they occur is improper. There is, of course, a considerable amount of leeway as to when such expenditures are made. That the Corporation's practice reflects the element of flexibility is indicated in the 1932 annual report which says that "maintenance expenditures * * * include a substantial amount expended in order to keep inactive departments prepared for resumption of operations when business improves." Thus, the Corporation charged to 1932 costs, maintenance expenditures which it admits were necessary either on account of past or future operations but not to current operations. And it should be noted that only a very small part ($469,000 out of $28,000,000) of the current expenditures were not charged to current costs, while $1,300,000 was charged to current costs to build up the reserve account.

Application of the statistical technic used in the Corporation's cost analysis to the maintenance and repair data gives the following results:

	"Fixed" costs per year	"Variable" costs per ton	Coefficient of correlation
Total (1927-38)	$5,320,000	$8.356	0.98
Excluding railroads (1927-36)	1,600,000	6.320	.97
Railroads (by subtraction)	3,720,000	2.036	

No adjustments have been made for wage and price changes similar to those in the analysis. Such adjustments would tend somewhat to raise the "fixed" and lower the "variable" costs.

If my analysis of maintenance and repair expenditures presented thus far is correct the Corporation's analysis is biased to the following extent:

1. "Variable" costs are overstated between $1 and $2 per ton because of the inclusion of railroad maintenance expenditures in excess of those "attributable" to shipments.

2. "Fixed" costs are understated by the inclusion of the total railroad maintenance expenditures.

The results indicate that the Corporation has practically adopted the "cost when spent" principle for maintenance. They also indicate that the Corporation has come close in its maintenance accounting to the principle of spreading such costs equally over all units of output. Had "equal spreading" been fully accomplished, the "variable" cost computations for maintenance excluding railroads would have been lower by about 10 cents per ton than the $6.32 figure obtained. The two figures are so close as to warrant the suspicion that they are the results of a conscious design.

The Corporation's policies with regard to depreciation and depletion, as stated in its S. E. C. registration statement, are—

1. Depreciation is charged on the straight-line method. When the actual operating rate is less than the predetermined average rate charges are reduced but less than proportionately and in no case by more than 50 percent. (Railroad equipment is, of course, depreciated at rates approved by the Interstate Commerce Commission.)

2. Depletion is charged by prorating the investment costs over the estimated recoverable quantity.

The Corporation's policy with regard to depreciation is only one of many that might have been followed, and is apparently a compromise between charging equal amounts per unit and equal amounts per annum. On an equal charge basis, the statistical computations would show an annual "fixed" cost of about 53 million dollars but no "variable" cost; on an equal per unit charge basis, the computations would show no "fixed" costs but a "variable" cost of about $5.30 per weighted ton. It is easily seen that the actual results of 29.5 million dollars for "fixed" and 2.37 for "variable" costs obtained by the Corporation are about halfway between these two extremes.

Our analysis assumes, of course, that the depreciation and depletion figures which the Corporation uses in its cost analysis are the appropriate ones in the sense that they are computed in accordance with a general policy that does not change from year to year. But the records at my disposal indicate that this may not be so.

(Senator King assumed the Chair.)

Acting Chairman KING. Depreciation and depletion, especially in mines, that is largely fixed by statute.

Mr. TAITEL. It is fixed by statute in terms of statements for tax purposes. It is not fixed by statute in terms of what corporations may charge on their own books for their own purposes.

Both the 1927 and 1928 depreciation figures in the Corporation's cost analysis include about 11.5 million dollars of charges to a bond

sinking fund reserve used "to cover amortization of appreciated cost to it (the holding company) of investment in stocks of subsidiary companies in excess of their own investment in tangible property." Such charges were made in years prior to 1929 but not in later years. It is not clear whether these charges simply make up for under-depreciation on the books of the subsidiaries, i. e., represent the basis for transfers in excess of earnings from the subsidiaries to the holding company in order to fulfill the conditions of the bond indenture, or whether they are bona fide amortizations of intangibles by the holding company. Just how these amounts should have been handled in the cost analysis depends, of course, upon the continuity of depreciation policy during this period.

Also included in depreciation were charges of about $1,000,000 in 1932, $400,000 in 1933, $450,000 in 1934, and $400,000 in 1935 "normally included in the value of the season's production of ore carried in 'inventories'." These charges belong, of course, in other accounts. However, their inclusion in the depreciation account has only a minor effect on the statistical results.

Conversely, about 7 million dollars in 1936, 8 million in 1937, and probably a somewhat smaller amount in 1938 were excluded from the depreciation item included in the cost analysis. These amounts represent charges against a special reserve set up in 1935 on the books of the holding company presumably to make up under-depreciation in prior years. The extent to which changes in depreciation rates occurred is not clear.

The depreciation and depletion figures used in the cost analysis do not include a comparable item for amortizing "investment in stripping and development of mines and structural erection equipment."

Acting Chairman KING. Do not take into account the credit to which they would be entitled in their balance sheet?

Mr. TAITEL. What I am saying is that the depreciation and depletion figures used in the Corporation's analysis as depreciation and depletion figures do not include the item on the books of the Corporation for investment in stripping and development of mines and in structural erection equipment. Those expenses are not included in the Corporation's analysis under the item of depreciation and depletion.

Acting Chairman KING. Would that be to their advantage in obtaining offsets?

Mr. TAITEL. Well, they are charged or entered as costs on their books, but they are in separate accounts. The cost analysis, having taken the depreciation figures, as I understand it, from the annual reports, does not include the stripping and development expenses, and the structural erection equipment expenditures. The item is charged directly to property accounts and not through reserves.

The Corporation's policy with regard to this item is, according to the registration statement, to charge the stripping and development part to cost in the same manner as depletion, and the structural erection equipment part in the same manner as depreciation. Another indication of the depreciation and depletion character of the item are the wide differences from year to year between expenditures and charges to costs shown in table VI of "Exhibit No. 2185."

No doubt the Corporation has reasons which are valid in terms of operating and related purposes for not handling the stripping and development expenses as depreciation and depletion.

Acting Chairman KING. Where would you place upon the books that you were keeping the cost for stripping and for depreciation? What column would you put those costs in?

Mr. TAITEL. The method of accounting which the Corporation uses in handling its stripping and development expenses is a perfectly good one. The only difference between that method and the method used for the regular depreciation and depletion account is this: When an expenditure is made for stripping and developing, it is entered directly as an investment; when a charge is made to costs, the amount is entered in the same investment account, instead of in a separate depreciation or depletion account.

I do not intend to imply that the Corporation is using bad accounting practices. It is a perfectly legitimate procedure and the procedure is stated very clearly in the annual reports.

Mr. WALTER WHITE. You mean by that that they charge stripping expense, for instance, to ore that is being mined from somewhere else, in the current year, instead of to the ore which will be mined underneath that stripping in a subsequent year?

Acting Chairman KING. Perhaps the question is not clear. Will you repeat it?

Mr. WALTER WHITE. Whether the stripping is charged, or the stripping over a certain ore body is charged to operating expense, in connection with ore receipts from somewhere else—that is, that year's operation is not held in a suspense account to be charged against it, or which underlies the particular body of ore that is being stripped?

Mr. TAITEL. As I understand the accounting procedure, as the annual report states it, when they make an expenditure for stripping, they charge it to the property account, that is, it is an addition to the property asset, it is an investment. In essence, it is a suspense account, as you put it. Later, when the ore is mined, it is charged to the ore mined.

Mr. WALTER WHITE. I should think that would be the proper or usual practice.

Mr. TAITEL. I don't know whether it is the usual practice. I simply state that that is what the Corporation does.

But whatever the reasons for so doing, those reasons cannot justify the treatment of stripping and development expenses in the Corporation's cost analysis. Particularly should the item have been segregated in the cost analysis since it is included in "Other Expenses," a cost category treated in the cost analysis as if it represented current purchases of goods and services.

The "variable" cost for stripping, and so forth, is higher by about 14 cents per weighted ton than the over all average of 40 cents for the 12 years. This does not indicate a close correspondence with a policy of allocation directed toward obtaining equal per unit costs, but rather a tendency on the part of the Corporation to charge larger amounts per unit the larger the output and the income realized. In view of such a tendency, it may be said that the particular treatment accorded to stripping and related expenses biases the "variable" cost derived in the Corporation's analysis slightly upward and the "fixed" cost slightly downward.

Criticisms of the nature presented do not, of course, negate the hard facts of total costs. In the long run, cumulated total costs as they appear in the income account as charges approximate actual cumulative money costs. And over a long period of time, money costs are determinative. They must be met by receipts if a profit is to be made and if the Corporation is to remain in business. But this is true only in the so-called long run. In the short-run periods, and it is in the short run that prices are made, total costs as figured in the Corporation's analysis are not the facts upon which pricing is based.

Nor is the implication that a cost-volume relation pertinent to pricing would have been obtained had more appropriate treatment been accorded to the various cost items mentioned. Rather, with regard to the technical features of the criticism our examination of the figures upon which the Corporation's analysis rests has shown that, in terms of the Corporation's own framework of analysis—the applicability of which to the problem I have grave doubts—the Corporation's estimate of "fixed" cost is biased downward and the estimate of "variable" cost is biased upward.

My conclusion with regard to the substantive features of my analysis is that a division between fixed and variable costs obtained from a statistical analysis of historical data, such as the Corporation has made, bears but a nebulous relation to the actual division of fixed and variable costs which bears upon a particular act of pricing. The question may fairly be raised whether the Corporation has ever before had prepared for the guidance of its executives cost analyses of the type presented to this committee for the purpose of helping those executives solve their pricing problems. And I am led to believe that the Corporation's cost analysis is not a description of what in fact has guided its pricing policy but is being used as a rationalization of the actual pricing practices pursued by the Corporation in the past.

It is, of course, possible to modify the statistical analysis used by the Corporation's analysts so that it would present cost schedules relevant to the particular pricing problems the Corporation faces. Such modification, however, would in my opinion stop little short of destroying the whole theoretical basis on which the Corporation's analysis rests. But it would provide the best descriptive measurements available from the bag of tricks of modern methodology.

The modification would be based upon an insistence that the division between fixed and variable costs or a cost-volume relation meaningful for an actual price decision is not a unique relation applicable to all possible circumstances and therefore to none. For a general statement, the most appropriate presentation is in terms of upper and lower limits. As the conditions under which the cost figures are to be used converge more and more to a concrete pricing situation, the limits would be narrowed. For a particular pricing situation, the range between the lower and upper cost estimates can probably be small enough for practical purposes. But the estimates of this type would bear no consistent relation to the Corporation's cost-volume curve.

In general, the lower limit for a cost estimate used for pricing in connection with a particular prospective volume—the real hard cost that must be covered if business is to be accepted—would be much below the one indicated by the Corporation's analysis. It might be

above. But where it would fall depends upon a wide range of practical circumstances, such as the condition of the plant, the position of material suppliers, the degree to which the working force needs to be rearranged for production at the contemplated new level, and so on.

The upper limit, in general, would be above the cost-volume curve of the Corporation's analysis. This must be so since the Corporation in particular, and almost any business in general, is not immune from the drive to cover sunk costs as quickly as possible. For a general statement applicable to a whole range of ordinary practical circumstances, it might be taken as the minimum amount which a business must cover in order to carry on over a very long period. This is roughly equivalent or in rough conformance with accounting principles as usually stated and applied. But in a particular pricing situation the pertinent upper limit of costs bears no necessary or consistent relation to the generalized upper limit.

In brief summary, the theoretical calculations submitted by the United States [Steel] Corporation analysts] I would regard as highly interesting applications of refined econometrics, but of little use to the committee as a description of the actual considerations upon which steel price decisions are based.

Acting Chairman KING. Any questions? Thank you very much, Professor.

Call your next witness, Dr. Kreps.

Dr. KREPS. I would like to keep Mr. Taitel on the stand. While we have greatly taxed the patience of Dr. Yntema, I am sure he would like to make some comments on Mr. Taitel's analysis, reserving such specific questions as he may have on Dr. Ezekiel's analysis, which Dr. Ezekiel ought himself to answer, until Friday morning, when Dr. Ezekiel can be back in town. Unfortunately, he had to leave at 4 o'clock this afternoon.

Acting Chairman KING. Would you prefer to resume the stand now, Doctor, or perhaps you would rather wait until the morning?

Dr. YNTEMA. I should much prefer to comment on this tomorrow morning. I have had five documents to read and this is the first time I have had an opportunity to hear this discussion. I could deal with the general aspects of it now, and in a sense, I did so this morning. But I think that my comments would be more valuable to the committee if I could make them to morrow morning.

Acting Chairman KING. I think perhaps that would be better.

Dr. KREPS. I should like to point out to the chairman that the hearings might thereby be considerably delayed. We have a witness for tomorrow morning and tomorrow afternoon. All of us would like to make these hearings as brief as possible.

Dr. Yntema has had this paper [1] since yesterday. As he has himself acknowledged, he made some comment this morning. If possible, and if it does not transgress on his patience and his energy too much, he would really help us to keep the hearings brief if he could make his comments this evening. The hour is still early.

Acting Chairman KING. I think if the witness has to go over his paper and present it, then if you ask the man offhand to reply to it, I think you ought to give him a little more time.

[1] Refers to a prepared statement from which Mr. Taitel read.

Dr. YNTEMA. Senator, this is merely the point——

Acting Chairman KING (interposing). And there would be no delay as far as the committee is concerned. If it would not delay you, if Dr. Yntema can come back——

Dr. YNTEMA (interposing). I can make comments on the general question. I cannot obviously, on such short notice, comment on highly technical points. I am prepared to comment both on Dr. Ezekiel's paper and on the paper which Dr. Bean is scheduled to present.[1] I am quite willing to proceed if the committee so desire.

Acting Chairman KING. Well, if you are willing to proceed, if you think that would be better, that you would make a better presentation by waiting until tomorrow, as far as the chairman is concerned, we won't force a witness to testify when he isn't quite ready to testify.

Dr. YNTEMA. The general point to which I should address myself would be this, that in evaluating criticism which has been offered this afternoon—and I think in fairness, we should say this is a scholarly statement that we have just heard—in evaluating the criticisms which have been offered, I think it is important to keep in mind the relative magnitude of the various parts of the costs and the portions to which these comments apply.

As I pointed out in the discussion this morning relative to table 8 of "Exhibit No. 1416,"[2] there are two major elements in the total costs: The pay roll and the "other expenses." With reference to the matter of depreciation and depletion, the allocation among various years is, of course, arbitrary, and I think that Mr. Taitel would be reluctant himself to specify exactly what allocation was the proper one.

With reference to the matter of maintenance and the allocation of these other costs among years, the propriety of the allocation depends eventually upon what you mean by a variable cost and by a fixed cost. From one point of view, you might insist that those maintenance and repair charges should be allocated equally over every one of the years. From that point of view, they would all become fixed costs. Or you might say that they should all be allocated in proportion to the volume of output. Or you might say that they should be allocated in such a way as businessmen do allocate them, confronted as they are with the ups and downs of business.

Now, the last is substantially the definition of variable costs which we have used. We have in our separation of costs between fixed and variable, attempted to adjust as best we could, for the effects of changes in the wage rates and the prices and the tax rates, which the Corporation must pay at different points in the cycle. We have attempted to adjust also for the change in efficiency as reflected by the downward trend in the costs. We have not eliminated such inequality in the distribution of maintenance items as results from adjustments to the ups and downs in volume of business, and I submit to the committee that that is the appropriate treatment of the item.

I should take issue with the criticism which has just been made, that maintenance cost is really a cost which ought to be allocated equally year by year so that it would thereby become fixed rather than variable. But I have no quarrel with that; it is merely a matter of definition of terms. I suggest that the definition I used was the appropriate one.

[1] Dr. Bean's testimony begins infra, p. 13719.
[2] Appendix, p. 14040.

Acting Chairman KING. How could you make that a fixed charge when one plant with the same uses may become obsolete in, say, 5 years, and another in 20 years? How could you say that that should be a fixed charge and should be the same during that entire period?

Dr. YNTEMA. My opinion is that we have handled the situation correctly for the purpose with which we were concerned, namely, a study of how costs fluctuated in the business cycle, and the possibilities of reduction in costs in the cycle. It seems to me that the best guide we could take in the situation is what businessmen did do when they were confronted with the kind of phenomenon which we are now considering. That was their reaction to the pressure of changes in volume of output.

Acting Chairman KING. I know of cases where valuable machinery by reason of some technological development has become obsolete within 2 or 3 years, whereas other machines treating ores lasted for several years. In the first instance, they became obsolete in 1 or 2 years, and should have been charged off during that year instead of being continued over several years.

Dr. YNTEMA. May I read for the committee one of the introductory paragraphs in this statement by Mr. Taitel:

> So far as prices in such an industry are based upon costs, the pricing policy would tend to be one that provides for declining prices as volume of output increases. Prices in the steel industry, however, have not followed this pattern. They have tended to remain relatively fixed. The typical practice has been to increase prices with increased volume rather than to decrease prices as sales expand. Such price behavior is much more consistent with the situation in which increasing output is associated with constant or rising costs.

That paragraph, it seems to me, abstracts to a considerable extent from the factors which really do account for the cyclical changes in costs and prices. The outstanding characteristics, which are important in determining the price in the market, are the tremendous shifts in demand in the business cycle. Those are outside the control of the Steel Corporation or the steel industry.

The second consideration which cannot be neglected is the changes in the prices which the Corporation and the industry must pay for the materials and for the labor services which they must have for the production of their product. It seems to me that those have been neglected in the particular suggestion.

I should like to call attention to the chart which was submitted by Mr. Taitel. I do not know, and I do not think the witness who presented it knew, the basic material from which it was constructed. Judging from what I know about the total costs in the Corporation, and from what I know about the cost behavior in many of the subdivisions, I am inclined to be extremely skeptical as to the validity of the chart, at least until we know the basic data upon which the chart is constructed. I think that we ought to reserve judgment with respect to its validity.

Acting Chairman KING. I didn't hear all the testimony.

Dr. KREPS. The chart is on the easel, "Exhibit No. 2184."

Acting Chairman KING. Does the chart indicate a fixity of price for continued periods of time, say for coal or for ore or for freight rates, notwithstanding what we know to be the fact that has varied very much in price during the past few years, particularly since the

Bituminous Coal Act, and the price of ore varies, too, by reason of many conditions——

Dr. YNTEMA (interposing). Senator, I wish I knew the material from which this chart was prepared. I don't.

Dr. KREPS. You are on the same ground that we are when we try to evaluate your charts. Isn't that correct?

Dr. YNTEMA. No; that is not correct.

Dr. KREPS. We have in no case seen either the basic material or the work sheets. We know fully as much about Mr. Lippert's chart as we know about any of yours.

Dr. YNTEMA. But we don't even know in this case in the chart presented by Mr. Taitel whether there has been any adjustment for the prices paid for the materials, any adjustment for wage rates, any adjustment for changes in efficiency. There is no description from the material presented as to what the cost means from which this chart is derived, and I simply don't understand it, and I don't see how the committee can possibly understand it.

Acting Chairman KING. Does it assume a sort of continuous line, using the charts that we have, for costs and for those conditions?

Dr. YNTEMA. Senator, I simply don't know; I just don't know what it means.

Acting Chairman KING. We know that there are constant variables in so many of the activities connected with the steel industry, and for that matter, all industries.

Dr. LUBIN. May I ask the witness: Dr. Yntema, are you acquainted with Iron Age?

Dr. YNTEMA. Yes.

Dr. LUBIN. Do you accept it as a reputable journal?

Dr. YNTEMA. What do you mean by "reputable" journal?

Dr. LUBIN. In the sense that the members of the industry quote it as representing the points of view of conditions in the industry and as a good reporter of conditions in the industry.

Dr. YNTEMA. For some statistical purposes, I would say it is a good reporter. As far as individual articles are concerned, especially in a case as technical as this, I should say I would want to reserve judgment in appraising any particular article.

Dr. LUBIN. Do you know Mr. Lippert?

Dr. YNTEMA. I do not.

Dr. LUBIN. Do you know anything about his standing in the profession?

Dr. YNTEMA. I do not.

Mr. LUBIN. Do you know whether members of the Corporation or members of the industry look upon him as a responsible person?

Dr. YNTEMA. I do not.

Dr. LUBIN. In other words, then, when you question his data, you are not questioning his competency.

Dr. YNTEMA. Oh, no, not at all. I am merely saying that I don't know what this means, and until we have a description of what it is, I suggest that we can't interpret it properly. He may be completely competent. I don't mean to imply he is otherwise.

There recurs in the statements by Mr. Taitel as well as others the implication that we here have presented a guide for pricing policy by the Steel Corporation and by the steel industry. May I once again repeat that such is not the case, that we have attempted to present

a description of how costs vary with output upon certain assumptions. We have attempted to describe how the volume of steel sold by the industry varies with the price of steel to give some basis for judging what would be the effects of a change in the price of steel upon the quantity sold and upon the profits and losses of a corporation such as the Steel Corporation.

Dr. Kreps. The point you are making is very important. I want to underscore it. You emphasize that your analysis is "not a guide for pricing policy by the Steel Corporation and by the steel industry." It certainly is not a guide for the T. N. E. C. For example, let us examine a little more closely the costs which you are talking about. They do not apply to any particular steel product? Correct?

Dr. Yntema. The costs apply to all the steel products and the other operations of the Steel Corporation.

Dr. Kreps. To what you call the "product mix"——

Dr. Yntema (interposing). The composite total of all products.

Dr. Kreps. They do not apply to costs within any particular plant.

Dr. Yntema. They apply to costs within all plants.

Dr. Kreps. They only apply to costs within all plants of the Steel Corporation. They do not apply to costs within other plants and outside the Corporation, nor to the totality of such other plants in other corporations, nor to the steel industry as a whole.

Dr. Yntema. That is quite correct; our analysis of costs was necessarily restricted to the material we had in the Steel Corporation.

Dr. Kreps. In other words, your cost curve is what you regard a convenient summary of cost experience as you have seen it in the Steel Corporation throughout the period which you covered.

Dr. Yntema. If I may speak frankly, I don't like the word "convenient." I would say that it is an inappropriate description.

Dr. Kreps. I withdraw the word "convenient." The summary is one that you feel enabled you to get a good glimpse and to give us a good glimpse of what seemed to you to be the cost relationship for those 50,000 products in that varying product mix, composed of steel, cement, and the like.

Dr. Yntema. Yes, I think that is a correct statement.

Dr. Kreps. These are theoretical costs, not actual costs.

Dr. Yntema. They are actual costs adjusted to eliminate the effect of variables which we did not want to leave in because they would becloud the picture.

Dr. Kreps. But they are not actual costs of any actual product.

Dr. Yntema. But of the actual group of all products.

Dr. Kreps. Nor are they costs actually incurred in any actual plant.

Dr. Yntema. I think we covered that.

Dr. Kreps. The distinction is extremely important and is one upon which there is no disagreement. I merely want to help Dr. Yntema clear up the confusion.

Dr. Yntema. May I say in concluding these remarks that I appreciate very much indeed the scientific character of the discussion which has just preceded, but that, in appraising it, I don't think it alters substantially my views as to the applicability of our findings to the purposes for which they were designed.

Mr. Feller. May I just ask this question? Throughout this discussion I have kept recurring in my mind this question: Here is a very

important problem to be examined. Dr. Yntema has examined it in one way. Is it possible to examine it in another way? Dr. Yntema, I should like to ask you from your experience with the materials at hand in the Corporation, would it have been possible to have dealt with this problem of the variations in costs at different rates of output by taking the costs of a particular plant of the Corporation, and instead of using these historical aggregate costs, to have considered the costs of the various operations that go into making steel?

Dr. YNTEMA. Mr. Feller, we considered that with great care before we undertook our analysis. Our decision as to procedure was dictated by these considerations: First, we were fearful if we came to the committee with costs which involved necessarily arbitrary allocations of overhead that we should be criticized for any allocation that we made because any such allocation is to some extent arbitrary. In the second place, we thought the committee would be more interested in the total picture than in the picture presented in the individual plant. We did, as a matter of fact, make numerous studies of the variation in costs with output for short periods of time in individual plants, all of which confirmed the findings which we have here presented with respect to linearity, the straight line behavior of total costs with volume. Of course, the absolute level of those costs was not material for the general purpose which we had in mind.

I should like to point out also that even if we were to take an individual plant we would encounter the same type of difficulties that we encountered here. Furthermore, the work would mount to unreasonable proportions because each plant produces not one product but many products, and for each plant, therefore, it would be necessary to construct an index of production to relate to costs, and we should have to make all the types of adjustments we have here. The job would be so complicated if attacked in that way and the results would be subject to such great question that we did not think it desirable to approach the problem in that manner.

Dr. LUBIN. I should like to ask Mr. Yntema just a question or two in regard to methodology. Mr. Yntema, if United States Steel Corporation would ask you to appear and do a job for them on costing, there are six or seven products on which there is doubt in the minds of certain officials as to whether the price they are charging is the right price, right, being the economic price, would you proceed to do the job the way you did this one here?

Dr. YNTEMA. The question you are asking is a very different question from the one we posed, and I should say that consequently I should approach it in a different way. I should go on further, if I may, Dr. Lubin, and point out that your question is still an ambiguous one.

Dr. LUBIN. Let's be specific. A certain vice president of a very large corporation commented to me recently, he doesn't know how his prices are fixed. He was interested in three products. If he asked you to come in and check up and find out whether the price they are charging is a proper economic price, particularly in view of its relationship to costs, and give them a cost picture——

Dr. YNTEMA (interposing). The proper economic price, according to my view of things, is the price that you can get in the market. It is not determined in the short run by costs; it is determined primarily by what your competitors will offer the product for and

what the public will pay for it. It doesn't seem to me that in a competitive situation the function of costs in the short run is to serve as a basis for the establishment of price. That is what I referred to in raising the issue with respect to the interpretation of your question.

Dr. LUBIN. Let me change my question and be more specific. If you were asked by this official to tell him whether or not the price that they are receiving is such that it makes the Corporation a good profit on the basis of its cost, would you proceed the way you have in this?

Dr. YNTEMA. No, because the question is different from the question to which we addressed ourselves. We were not concerned in this particular problem with the individual product prices, the reasons for that I have tried to point out. If it had been possible to present unambiguous results, and the burden of expense and time had not been too great, we should have been only too glad to attack that problem, but we worked (*a*) under limitations of time and expense, and (*b*) also under limitations that are theoretically inherent in the problem, that is, with reference to the allocation of overhead or fixed costs.

Dr. LUBIN. In other words, frankly, my purpose in asking this, I am trying to formulate in my own mind what these figures are good for.

Dr. YNTEMA. These figures are good, if I may say it again, for these purposes; we wanted to find out on the demand side how the total quantity of steel sold would vary with the price. You might approach that product by product. I think you would get into difficulties which would make your problem insoluble if you did so, because of the substitutability among products. In the second place, we wanted to find out how the costs in a concern such as the Steel Corporation varied with output to discover what would be the effects of price reductions or price increases upon the costs of such a corporation. We merely want to present such information to the committee.

Dr. LUBIN. In doing that latter, you had to use certain arbitrary assumptions.

Dr. YNTEMA. It depends upon what you mean by "arbitrary assumptions."

Dr. LUBIN. You had to make a decision, Shall we allocate this way, or that way?

Dr. YNTEMA. That is just what we didn't do for the most part. We attempted to select a method which would minimize the necessity of arbitrary allocation. That is why we did what we did; we didn't want to engage in any more arbitrary allocation than was necessary.

Dr. LUBIN. Wasn't selection of the method itself an arbitrary thing? You might have selected another method.

Dr. YNTEMA. That is quite right, but the selection of the method is arbitrary only insofar as there is a set of alternatives for the purpose you have in mind.

Dr. LUBIN. What I am trying to get to is whether or not Mr. Feller hasn't really struck the kernel of things, that the same job might have been done by somebody equally well with a different set of assumptions and different set of methods and gotten entirely different results, and although you might not have agreed, there might have been people who did, in fact you might have found two

corporations doing this thing differently, getting different results, and both having authority for their methods.

Dr. YNTEMA. I see what you are driving at, I think. Let me say this in answer to it: I think it is possible, given sufficient time and money and patience, to study the relationship of the costs which are associated directly with individual plants in relation to their output. The problem is an overwhelmingly great one if you are going to cover any considerable territory, and it still leaves untouched a certain important realm, that is, namely, the allocation of the overhead not associated with those individual plants. To some extent you can get part way in the problem, but there still is a margin of indeterminancy in any solution that you obtain by it.

Acting Chairman KING. That becomes more of a problem if you have several hundred or several thousand commodities growing out of this same general activity.

Dr. YNTEMA. You would have the same problem, plant by plant, as you have in dealing with the total corporation.

Dr. LUBIN. I had an old professor once you probably know him, Henry Carter Adams, a man who instituted the first series of accounts for the Interstate Commerce Commission. The first sentence he always told us in his classes was that accounting was purposive; your purpose would determine the method you used. I wonder whether the same wouldn't be applicable to the testimony you have presented.

Dr. YNTEMA. I think that is a very important question which you have raised. We selected this method on the basis of two considerations, its applicability of method and the exigencies of time and expense. And I should like to point this out, if I may: That neither ordinary accounting records nor cost-accounting records reveal immediately the kind of data which we needed, and that is why we resorted to this type of analysis which we think is applicable to the problem for which we designed it.

Mr. FELLER. I should like to ask you another question along this line. As I understand the method used, the fundamental, the basic datum in the whole thing is a chart, a scatter diagram, as statisticians call it, on which you place 12 dots. It all began from that, didn't it, the cost-volume relationship in each of 12 years?

Dr. YNTEMA. I think there is some misapprehension on the part of those who have participated in the discussion as to the relative importance of the demand side and the cost side. I should say that the inelasticity of the demand for steel is important as well as the cost behavior. I should deny that it all started in this one little scatter diagram.

Mr. FELLER. I agree with you and I would like to amend that. I was addressing my remarks entirely to the cost analysis. I may say that my question might be quite different if I were addressing myself to the demand. Just to narrow down my question, have you tried, or is it possible to try, to put more dots on by taking more years? In other words, supposing you went back to 1906 and plotted that, have you tried checking your results by taking more years?

Dr. YNTEMA. The reason for the selection of the years which we took was that we did not have satisfactory records for the adjustment of the pay rolls for prior years. I don't want the impression to remain that the evidence in the chart is the only evidence on which we based our final conclusions. We confirmed this study, as I said, by numerous

other studies, and speaking now as a statistician and economist, I was amazed to find how closely in so many cases the total costs were almost precisely a linear function of output. It was one of the real surprises of my life as an economist.

Mr. FELLER. Was it possible to test the result, that is, the linear result, by analyzing the profit-and-loss record of the Corporation?

Dr. YNTEMA. I don't think that would give nearly as satisfactory results as this. If you take the profit or loss record, the profits or losses are a function both of the prices charged and the costs which are involved, and it does not seem to me that that is an appropriate type of analysis.

Mr. FELLER. I would like to put it to you concretely. Supposing you took the records of operation of the Corporation from July 1938 to January 1940—now, that is a period that covers six quarters—in which there has been no substantial price change, wouldn't that be a good test period, not necessarily to derive a line like this, but to test whether or not the line that you have derived is an accurate one?

Dr. YNTEMA. Well, there are difficulties in that. For one thing, you will run into some problems in connection with seasonal variations of cost. There is one difficulty in connection with that that is rather serious.

We did test out our material by studying the variation of pay rolls and of hours worked with output, and got confirmation of our findings. I should be rather skeptical of the sort of procedure you suggest, and again I want to make clear that we did not have all the time in the world to undertake the study. We were limited.

We were engaged in a large number of other studies besides this one, and we made the best of what facilities we had. I doubt very much that the profit-and-loss analysis you suggest would throw great light, however, on the problem

Mr. WOODEN. Might I ask a question? Dr. Yntema, can you say whether the average price level in 1939 was less than in 1938?

Dr. YNTEMA. May I answer that with a chart? I think I can show that very easily.

Mr. WOODEN. I mean for steel.

Dr. YNTEMA. May I show you that by chart?

Mr. WOODEN. Any way you like.

Dr. YNTEMA. Let me present this chart, if I may. This chart is numbered C-9, "Exhibit No. 1409." It is entitled, "Reported Composite Price and Composite Mill Net Yield." [1] The heavy line in the chart represents an index of the composite mill net yield to the United States Steel Corporation subsidiaries. The dotted line is the reported composite price by "Iron Age." This line extends in 1939 through November, and it is apparently from inspection of the chart that the average price reported by "Iron Age" is substantially lower in 1939 than in 1938, and also that the composite mill net yield to the Corporation is similarly substantially lower in 1939.

Mr. WOODEN. Is it as much as 10 percent lower?

Dr. YNTEMA. The reduction from the high point in 1938 to the low point in 1939 is from 105.9 for the mill net yield to 91.4 That would be a drop of 14.5 points, a drop of approximately 14 percent from the high point in 1938.

[1] Appendix, p. 13815.

Mr. Wooden. On page 16 of your prepared statement which you read, you estimated that a 10 percent decrease from the 1938 average level would produce only 11 percent increase in volume.

Dr. Yntema. No, we didn't estimate that. What we said was that was more than the most optimistic response which could be expected. We didn't mean to imply that we thought that was a reasonable expectation.

Mr. Wooden. Was that more than could be expected?

Dr. Yntema. Oh, yes. Our best guess is that the elasticity of demand was probably not more than 0.3 or 0.4, that a 10-percent reduction in price probably wouldn't of itself bring about more than perhaps a 3 or 4 percent increase in volume. That was a very crude estimate; it may be more than that, or less than that.

Mr. Wooden. Is that consistent with the fact that during 1939 the total volume for the industry increased as much as 65 percent?

Dr. Yntema. Our statement is not at all inconsistent with the facts. We went to considerable length to point out that the primary factors determining the quantity of steel sold, are industrial profits, national income, or, if you want to put it in another form, other industrial activity, and that the price is a relatively minor factor. I should say that the evidence for the years which you cite bears out exactly the findings which we have submitted to the committee, that there were other factors far more important than price which determined the course of events in those years.

Acting Chairman King. Any other questions?

Dr. Lubin. Is it possible to find out how much these other factors weigh as opposed to price changes?

Dr. Yntema. That is a far-reaching question, Dr. Lubin, and a very good one. One of the devices open to us is to attempt a multiple correlation analysis. The results of such analysis have been taken somewhat more seriously by the committee than I thought they would be taken. I should regard the results of our correlation analysis as merely confirmatory of our other findings, and I should not attach great precision to the results which are obtained thereby. I think they do, however, give us some evidence on a very complicated, difficult problem.

Acting Chairman King. Thank you very much, Doctor.

Dr. Kreps. I suggest that Mr. Taitel be dismissed as a witness. Dr. Yntema will probably wish to make comments later on.

Dr. Yntema. I should like to respond to several of the points which Dr. Ezekiel raised in his testimony

Dr. Kreps. That may be done tomorrow.

Acting Chairman King. The committee will stand adjourned until 10:30.

Dr. Kreps. I should like to add a word of thanks to Dr. Yntema, who consented while the material is still fresh in our minds, to stay with us and give us the benefit of his additional comments.

Acting Chairman King. I think we are indebted to him.

(Whereupon, at 4:45 p. m., the committee recessed until 10:30 a. m., Thursday, January 25, 1940.)

INVESTIGATION OF CONCENTRATION OF ECONOMIC POWER

THURSDAY, JANUARY 25, 1940

UNITED STATES SENATE,
TEMPORARY NATIONAL ECONOMIC COMMITTEE,
Washington, D. C.

The committee met at 10:45 a. m., pursuant to adjournment on Wednesday, January 24, 1940, in the Caucus Room, Senate Office Building, Joseph J. O'Connell, Jr., special assistant to the General Counsel, Treasury Department, presiding.

Present: Mr. O'Connell (acting chairman), Senator King, Representative Williams.

Present also: John V. W. Reynders, representing the Department of Commerce; Walter B. Wooden, representing the Federal Trade Commission; Frank P. Smith, representing the Securities and Exchange Commission; Martin Taitel, senior consulting economist, Work Projects Administration; A. H. Feller, special assistant to the Attorney General, and Melvin G. deChazeau, consulting economist, Department of Justice.

Acting Chairman O'CONNELL. The committee will please be in order.

Dr. Kreps being ill today, Mr. Feller is going to take his place. Will you introduce the first witness, Mr. Feller?

Mr. FELLER. Mr. Chairman, I imagine that my ignorance of the science of econometrics is almost unparalleled, and I may be in considerable difficulty in conducting examination of this very abstruse science.

Yesterday afternoon, the committee may remember, Dr. Yntema pointed out that his analysis had two parts of great significance. One part was the analysis of cost and the other was the analysis of demand. The testimony yesterday was concerned mainly with the analysis of the cost situation by Dr. Yntema. I should like to call to the stand Dr. Louis H. Bean, who, I understand, will discuss the other problem, the problem of demand.

Acting Chairman O'CONNELL. Will you hold up your right hand, Dr. Bean, please. Do you solemnly swear that the testimony you are about to give in this proceeding will be the truth, the whole truth, and nothing but the truth, so help you God?

Dr. BEAN. I do.

TESTIMONY OF DR. LOUIS BEAN, ECONOMIC ADVISER, DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

Mr. FELLER. Dr. Bean, will you state your name and position for the reporter?

Dr. BEAN. Louis H. Bean, economist in the Bureau of Agricultural Economics of the Department of Agriculture.

Mr. FELLER. How long have you been with the Department of Agriculture?

Dr. BEAN. I have been with the Department of Agriculture 16 years.

Mr. FELLER. And you are primarily a statistician?

Dr. BEAN. I am primarily an economist, doing a great deal of statistical work.

Mr. FELLER. Where did you receive your training as statistical economist?

Dr. BEAN. I am a graduate of the University of Rochester, Rochester, N. Y., and Harvard School of Business; since graduating from the Harvard School of Business, I have been with the Bureau of Agricultural Economics.

Mr. FELLER. Do you have a statement, Dr. Bean?

Dr. BEAN. I have a statement.

Mr. FELLER. Will you proceed?

EXAMINATION OF UNITED STATES STEEL CORPORATION ANALYSES

Dr. BEAN. An examination of the four U. S. Steel Corporation statements on demand analyses for steel in the container, automobile and railroad industries and for all industries combined, reveals grave statistical defects. These are defects in methods of analysis as well as in assumptions and in data. In the first three of these studies, the important objective was to reveal the effect of price on consumption, but the methods and data used were inadequate, with the result that the quantitative conclusions arrived at are unreliable, and so generally recognized by the authors. In some cases adequate data were not fully utilized and important price-volume relationships remained undetected.

In the study dealing with total steel consumption by all industries, several of the quantitative analyses presented are statistically unreliable because of the wide range within which the "true" relationships between price and volume may lie. No account was taken of the extent to which one or two extreme observations influenced the results obtained. In certain cases where the analyses show little influence of price on volume, a close examination of the data used reveals substantial price influence; and in cases where low prices were found to be associated with low volume, the underlying relationships can be shown to be just the opposite.

The conclusion of the analysis of the demand for steel in the automobile industry is that the elasticity of the demand for steel used as a raw material in the automobile industry is very low, and that a 10-percent reduction in the price of automotive steel would increase car sales by only 1⅓ percent and the consumption of automotive steel by not more than 2 or 3 percent.

In support of this conclusion, there is presented on page 19 a scatter diagram purporting to show the relation of automotive steel prices to total automobile steel consumption for the years 1924–38. It is claimed that this scatter diagram of percentage changes in the annual consumption and annual average price "fails to indicate that lower steel prices are associated with greater quantities of steel purchased and vice versa." Actually, the basic relationship does indicate that lower steel prices are associated with increased consumption of steel

in automobile production. The failure of the authors to note this is due to the fact that there are other factors besides the price of steel which cause changes in the total consumption of steel in automobiles and that statistically it is not possible to determine the effect of one factor on another when the other important elements in the problem are not taken into account.

(Senator King assumed the Chair.)

Acting Chairman KING. General improvement in conditions would necessarily increase the production and sale of automobiles, without much regard for the price of steel.

Dr. BEAN. If that factor is not taken into account, Senator, then the underlying effect of price on volume cannot be clearly seen.

Acting Chairman KING. There are so many factors that must be taken into account in determining the question of costs, cost prices.

Dr. BEAN. That I take it was gone into quite thoroughly yesterday. In a moment, Senator, I think I shall be able to indicate to you how it is possible to take this factor of demand into account in this particular illustration.

Had the authors of this analysis taken into account changes in the level of demand, they would have found an inverse relation between the price of automotive steel and automobile steel consumption. Even in the scatter diagram on page 19 it is clear that the relation of price to consumption is negative, as is indicated by the observations for the years 1925 to 1929, inclusive. Similarly, the observations for the years 1930–32 and 1933–37 show the inverse relationships but at different levels of demand.

May I take a moment to illustrate what these words mean. The chart on page 19——

Mr. FELLER (interposing). Page 19 of "Exhibit No. 1413," [1] entitled "Analysis of the Demand for Steel in the Automobile Industry."

Dr. BEAN. This is an enlargement of that chart.

Now, the reason I call your attention to it is that it is used as a sort of clincher to the argument that price is relatively unimportant, and that as far as this illustration is concerned, it does not show that lower prices are associated with increased consumption.

I have already pointed out that in certain years, there is an inverse relationship. If you examine the data for the years 1925, 1926, 1927, 1928, and 1929 only, you find that the relation of price change to volume change is negative; that is, reductions in volume being associated with price advances. If you take another group of years in sequence, 1933, 1934, 1935, 1936, and 1937, these observations also lie along a negatively sloped regression. Similarly, if you take the price decline in years of business depression, namely, 1930, 1931, 1932, and 1938, you also have a suggestion that the relationship is negative. I want to come back to this illustration in another moment.

Acting Chairman KING. Doctor, have you taken into account in your study the, what shall I say, psychological condition of the people resulting from apprehensions of bad or good legislation, bad or good times, foreign affairs, possibility of protracted peace or of a violent war; are not all of those things to be taken into account when you are trying to formulate a rule, if you can call it a rule, for the determination of the cause of the rise or decline in prices?

[1] Appendix p. 13993.

Dr. BEAN. Your question, Senator, leads me to think that I ought to make clear the position in which I appear here as a witness. I have not undertaken to analyze the supply and demand factors for the steel industry. I have spent a great deal of time over these reports that have been submitted to you.[1] They are the kinds of studies for which many of us statisticians and economists have been waiting for years. They contain a great deal of very useful and interesting information. Having studied factors which affect agricultural and industrial prices, I have looked at these reports quite minutely to glean from them fundamental knowledge about the iron and steel industry. I am here merely to pass on to you, who undoubtedly have not examined these things in as close detail as I have, some of the over-all impressions that, as a statistician, I obtained from studying these reports. I have no original contribution to make except, perhaps, to indicate to you the method by which I examined these statistical reports.

Acting Chairman KING. Of course, you would concede that the situation in Asia, where Japan has obtained for a number of years large quantities of scrap and steel, would affect the prices more or less, or affect the market or the demand for steel?

Dr. BEAN. I would, yes.

Acting Chairman KING. And similarly, conditions in Europe, if we have peace or war?

Dr. BEAN. I think some of these unusual conditions show up suggestively in some of the material that I want to go over with you.

By introducing the additional factor of changes in industrial production (as a measure of changes in the level of demand) into this analysis, it can be shown that for a given reduction in automobile prices, the associated increases in automobile-steel consumption have varied directly with the rate of change in business.

When changes in industrial production are introduced in this analysis, we find that the price changes in the years 1933, 1935 and 1936 are associated with increases in industrial production of 14 to 19 percent.

Price changes in the years 1925, 1926, 1928, and 1929 with increases in industrial production of 4 to 10 percent; in the years 1927 and 1924 with decreases in industrial production of 2 and 6 percent respectively; and in the years 1930, 1931, 1932, and 1938 with decreases of 16 to 22 percent in industrial activity. The only 2 years for which the data seems to be out of line are 1934 and 1937 when factors other than the relatively small changes in industrial production apparently supported automobile-steel consumption at a relatively higher level. If bookings instead of the indirect measure of consumption used here were available, it is quite likely that these 2 years (1934 and 1937) would also show as consistent a relation of price to volume as we find for all the other years in this analysis.

In other words, in this chart[2] that I have just described there are 15 observations, 13 of these 15 lie in such a position as to indicate an inverse relation of price to volume, and the 2 exceptional years, were undoubtedly years of greater anticipations, speculation in industry, that distort the price volume relationship.

[1] Exhibits introduced by U. S. Steel Corporation.
[2] Chart 6 of "Exhibit No. 1413"; appendix, p. 13993.

Mr. O'CONNELL. You mean a decrease in prices associated with substantial increases in demand in those years.

Dr. BEAN. May I illustrate by referring to chart 6 of "Exhibit No. 1413."[1]

I would like to take years when business was rising rapidly, somewhere between 15 and 19 percent per year. There are three cases of that sort in this analysis. They are these years right here, 1933, 35, and '36, and I think any of you dealing with just those 3 years would observe that the relation of these three points is such as to indicate a negative relationship at this level of demand. These other years when business was rising rapidly are here. Let's now take years when business was rising moderately, somewhere between 4 and 10 percent a year, instead of 15 to 19. The years of that type are 1925, '28, '26, and 2 additional years, '34 and '37.

There is another type of situation, namely, when business is declining rapidly, as in the years 1930, '31, '32, and '38, and the underlying relationship here too is a negative one. These data show that the underlying relationship of price changes to volume changes is negative, if the different business situations are taken into account. This illustration is not conclusive evidence that price changes and volume changes do not reveal a negative relationship.

Acting Chairman KING. You appreciate, I suppose, Doctor, that the introduction into our stream of economic business life, a very large Federal contribution, such as 2 or 3 billion of dollars during the bonus period, and the large appropriation of more than $3,600,000,000 just for relief and other matters in 1933, would necessarily have some effect upon business and upon prices, it would revive in some instances and possibly result in a decline in other avenues of business activity.

Dr. BEAN. But none of these things, Senator, alter the basic fact, if it is a fact, as revealed here that the relation between price and volume is basically inverse. That relationship may be hidden completely by the things that you have mentioned, but the underlying fact of an inverse relation between price and volume isn't altered. The things you mention may swamp that basic relationship, if we may put it that way, or cancel it; but price nevertheless has its basic influence and my point is merely that there is an inverse relationship between price and volume that can be revealed by the very materials which in this report it is claimed do not reveal it.

Acting Chairman KING. Well, prices are affected by the volume of currency and the credit extended with the banks. Isn't that true?

Dr. BEAN. Yes.

Acting Chairman KING. And, of course, business then reacts to those changes which result from the condition just alluded to.

Dr. BEAN. That is quite true. We are, however, talking about a report, Senator, which purports to portray the relation of price to volume with all of these other things held constant or held unchanged.

Acting Chairman KING. I am not talking about that report because some of these reports and some of the addresses of learned doctors and statisticians may not always afford a true basis for conclusions which may be reached with respect to causes and effects in the rise and fall of prices and in expansion and recession of business.

[1] Appendix, p. 13993.

Mr. FELLER. Dr. Bean, would it be correct to say that your testimony is directed to precisely the point that the Senator has just raised? In other words, does analysis and demand presented on behalf of the Corporation reveal a true picture of the relationship between price and demand?

Dr. BEAN. As far as this particular illustration is concerned, it does not to me. The statement is made in the report [1] that this analysis does not reveal an inverse relation of volume and price. By making a simple refinement in that analysis, I do find an inverse relationship.

The mere introduction of this additional factor representing changes in the level of demand not only gives clear indication of a negative relationship of price and volume but greatly clarifies the interacting and at times the counteracting influences of price changes and demand changes on the changes in the volume of automobile steel consumption. Thus for a 10 percent reduction in automobile steel prices, the associated increase in automobile steel consumption was about 80 percent when business activity was increasing at a rate of about 15 percent per year. It was about 50 percent when business activity was increasing at a rate of 5 to 10 percent per year, and about 20 to 30 percent with business conditions remaining unchanged. On the other hand, with business activity falling around 20 percent per year, a 10 percent reduction in automobile steel prices was accompanied by a reduction in automobile steel consumption of about 30 percent.

These relationships are not to be taken as final but merely as an indication that the general conclusion contained in the analysis of demand for automobile steel of a 0.2 to 0.3 elasticity of demand under normal conditions appears to be a substantial understatement.

The effect of price on the amount of steel used per car appears to be understated in this analysis. This may be judged by comparing the price of automotive steel (given in table 10 of "Exhibit No. 1413" [2] with the amount of steel consumed per motor vehicle. There is here an unmistakable inverse relationship between the price of steel and the amount of steel per car.

For example, in 1924 the price of automotive steel is given as 3.45 cents, the amount of steel consumed per motor vehicle is given as approximately 0.8 of a ton. By 1928 the price of automotive steel had been reduced to 2.67 cents and the amount of steel per motor vehicle had increased to 1.4 tons. Similarly, for the period 1929 to 1933 we find the price in 1929 of 2.69 cents associated with steel consumed per vehicle of 1.16 tons; and the lower price of steel in 1933 of 1.89 cents associated with steel consumed per vehicle of 1.8 tons. Conversely, the higher prices for steel in 1934–38 are associated with smaller steel consumption per car, averaging about 1.4 tons.

The exact relationship between the price of automotive steel and the consumption of steel per vehicle is difficult to determine. For the period of the 1920's the gross relation between price and consumption of steel per vehicle suggests an elasticity of 2 or more. For the period 1933 to 1936 the gross relation between price and volume of steel per vehicle suggests an elasticity of 1. For the entire period 1924 to 1938 the over-all relation suggests an average elasticity of somewhat less than 1. These figures are greatly at variance with the conclusion of the U. S. Steel Corporation analysis that "price considerations have a

[1] "Exhibit No. 1413".
[2] Appendix, p. 13997.

minor influence in determining the consumption of automobile steel" and that the elasticity of demand for steel as a raw material in the automobile industry is probably no higher than 0.2 or 0.3.

Mr. FELLER. May I just ask you a question there? The relationship which you have pointed out between the price of steel and the amount of steel used per car is a relationship, as I understand it, which is derived from observation of the historical data, and it does not necessarily suggest, does it, that the changes in the amount of steel per car were due entirely to the price factor; in other words, they may have been due to technical factors and to new styling and to new technological equipment which made it possible to produce lighter sheets or something of that sort?

Dr. BEAN. That is right. I merely call attention to these factors for this reason, that on the face of it, there is a significant inverse relationship between consumption and price. The report did not analyze that relationship so as to give an answer to the question you raise.

With respect to the demand for steel in the container industry, it is the conclusion of this analysis that the price of tin plate is of minor significance in determining tin plate consumption, and that in view of the inelastic demand for products packed in tin cans and the relatively small proportion of the price represented by the cost of tin plate, a reduction in the price of tin plate would be ineffectual in increasing the consumption of steel.

This study fails to develop any statistical proof of the major assumptions involved in these conclusions. In fact, there is a good deal of evidence in the data contained in this report which the authors failed to utilize and which shows price of both tin plate and of canned goods as much more important than was assumed here. In this study, there is no analysis of the relation between retail prices and consumption of canned products to indicate the nature of the elasticity for canned food products.

The conclusion that the elasticity here is small is merely inferred from an analysis of the National Resources Committee which correlated national income with consumption of canned fruits. The fact that that study cannot be used as a basis for inferring the nature of the relation between price and volume consumed and that the relation may actually be one of substantial elasticity is suggested by an examination of the relation between the price of canned tomatoes, the size of the pack of canned tomatoes, and the price of tin plate, the data being given in tables 12 and 13 of the report. If we assume that the price of canned tomatoes is determined by supply as measured by the size of the pack and by the price of tin plate, one of the important cost items, it is possible to observe both the nature of the relation of supply to price and of the relation of the price of tin plate to the price of a can of tomatoes. An analysis set up along these lines indicates, for example, that a pack of 14,000,000 cases in the 1920's was associated with a price of 13 cents per can, when the price of tin plate was kept at $5.50 per base box; and with a price of something under 12 cents when the price of tin plate was reduced to $5.20 or $5.25.

The elasticity of demand for canned tomatoes has changed a great deal during the period from 1923 to 1938, if the relation between the size of the pack and price may be taken as indicative. During the 1920's it appears that a 10-percent increase in the size of the pack

was associated with approximately a 2-percent decline in price, the price of tin plate remaining unchanged. In the more recent years, particularly 1935 to 1938, a 10-percent increase in the size of the pack has been associated with a 5-percent reduction in price.

These facts suggest that the elasticity of demand for some of the canned food products may be quite different from that assumed by the authors of the analysis of the demand for steel in the container industry.

Furthermore, the price of tin plate as a factor in determining the price of canned goods may be more important than the authors of these studies indicate. This is suggested by a comparison that may be readily made between the price of tin plate and the composite price of canned goods as shown in one of the charts on the board, and I shall point to that in a moment. It appears here that there is a high degree of correspondence and therefore correlation between the price of tin plate and the combined price of canned tomatoes, peas, and corn. Compared with the relation between the price of tin plate and canned goods prices in the 1920's, the prices of canned goods in the last 5 years have been relatively low. This reflects the effect of the large volume of production of canned goods, but except for that fact there is apparently an underlying relation between the price of tin plate and the price of canned goods which the authors failed to investigate and reveal.

And graphically, these words mean this——

Mr. FELLER (interposing). Dr. Bean, do you want to have that introduced for the record?

Dr. BEAN. Yes, please.

Mr. FELLER. Mr. Chairman, I should like to offer for the record, chart entitled—I can't see that from here.

Dr. BEAN. "Price of tin plate and of canned goods for the years 1923 to 1938, inclusive."

Acting Chairman KING. It will be received.

(The chart referred to was marked "Exhibit No. 2186" and is included in the appendix on p. 14124.)

Mr. FELLER. Would you also state for the record the sources from which the data were taken?

Dr. BEAN. The price of tin plate is taken from the report on the demand for steel in the container industry, the one I am just now discussing.

Mr. FELLER. That is "Exhibit No. 1415." [1]

Dr. BEAN. And the composite price of canned tomatoes, peas, and corn is also taken from this report, except that we have combined the three columns in one of the tables of this report as a composite average.

The over-all relationship between the price of tin plate and the price of these canned goods is of this sort, that for the years 1923 to 1928 or 1929 you have both prices of tin plate and prices of canned products at one level. Then both decline to approximately the same level in 1933, and both rise sharply in 1934. Since 1934 the price of canned goods has been relatively stable, but at a somewhat lower level than would be indicated by the previous relation between tin-plate prices and canned-goods prices, and I am suggesting that the very large volume of production of canned goods is partly responsible, if not

[1] Appendix, p. 14016.

entirely responsible, for keeping the price of canned goods relatively lower than the price of tin plate, taking the basic relation between them as that which existed prior to 1935.

The real significance of this illustration is that something more probably needs to be done in all of these analyses in the way of relating the price of raw materials, such as steel, to the price of the specific things in which steel is used. Here we have a very definite suggestion that steel is a predominant factor in the price of this consumer product, for which the general assumption was made that steel prices have very little influence.

The general conclusion that the price of tin plate is of minor significance in determining its consumption is not borne out by the aggregate volume and price data given in this report. If we relate the volume of total production of tin plate as given in table 9 to the price of tin plate given in table 12 (and adjust the price for changes in the general level of prices of goods other than farm food and iron and steel products referred to later), we find that the volume of tin-plate consumption has been subject to a marked expansion in demand ever since 1921, but that price has also been a factor in the volume consumed. On the average, price has been close to 60 percent as important as all other factors combined. Similarly, if volume of tin-plate output and industrial production are examined as factors in determining the price of tin plate, we find that tin-plate production is fully as important, if not more so, than industrial activity as a price factor.

Before commenting on the study of the demand for steel by all industries combined, it may be well to point to a general criticism of the price-analysis technique used in the analyses of demand for steel in the container, railroad, and automobile industries.

In the studies on the demand for steel in these industries, the relative unimportance of price is deduced from a set of scatter diagrams showing the relation between the year-to-year percentage changes in price of the appropriate kind of steel and percentage changes in the factor which represents the use of steel by the particular industry. In the case of containers this latter factor is the pack of tomatoes, corn, and peas separately; in the case of the railroad industry it is the deflated value of investment by railroads and railroad steel consumption; and in the case of the automobile industry it is automobile steel consumption. None of these scatter charts displayed any significant correlation and it was concluded that the price of steel was of very little importance, if any, in determining steel consumption in these industries.

One of the difficulties in this procedure is the use of only year-to-year percentage changes in one factor to show the existence or absence of relationship without taking into account other factors as well. It is elementary in statistical analyses that no reliable conclusions regarding the effect of one factor on another can be drawn unless the complicating influences of other factors known to be present have been isolated. It is therefore surprising that there is no indication of any attempt to include in this set of analyses any of the factors, other than price, which might affect the demand for steel in the particular industry. Under these circumstances, there is a good chance that no effect of price on steel consumption would be indicated even if price variations had really caused, say, half the variation in consumption. This point we have already illustrated in dealing with

chart 6 in the study on the Demand for Steel in the Automobile Industry,[1] and showed that where no negative relationship seemed to exist, the addition of an essential factor revealed unmistakably the existence of a negative relation between volume of consumption and price.

Turning now to the analysis of the demand for steel by all industries combined, in contrast with the foregoing studies, this one does make an attempt to establish statistically the nature of price elasticity for steel. Multiple correlations were made between various sets of factors and the elasticity of demand was measured for each price quantity regression obtained. The equations for nine such analyses are given in the appendix, but only four of these are discussed in the text.

All of these four analyses are inadequate in isolating any reliable estimate of the elasticity of demand. This becomes apparent when we look beyond the equation, which we can do by plotting the price-volume regressions and the individual observations adjusted for the influence of other factors than price for close scrutiny, and if the committee will bear for a moment with some of this technical lingo I will elucidate with some graphic material.

We have plotted the price-volume relations and the individual sets of data that they represent in one of the charts. In the first of these price-volume relations purporting to show the net effect of price on steel ingot production, practically no influence of price was discovered by the U. S. Steel Corporation analysts. The same data can, however, be made to reveal a negative relationship between the price of steel and steel ingot production instead of the slightly positive influence found by the authors of this analysis, indicating that the results here are, to my mind, indeterminate. The second price quantity relation is derived from the same data including two additional years, 1920–21, and the rate of change in industrial production instead of a trend factor, as the additional elements. The mere addition of these two years gives a fictitious positive relation between price and steel ingot production. This positive relationship is determined entirely by one point far beyond the range of the other observations. But for this one point the method and data used here would give a statistically insignificant and equally questionable price-volume relationship.

The third price-volume relationship is obtained in an analysis using industrial profits, consumer income, and a composite price of steel in relation to shipments. The relation of price to shipments as indicated in this study is a slightly negative one, indicating very little influence of price on volume and is also statistically insignificant. This result also is determined by two observations far removed from the range of the other observations. Excluding these two observations, the negative relation of price to volume is much more pronounced and appears to be fully three times as important as a factor-determining volume than the authors found it to be.

The fourth price-volume relation is obtained by relating steel bookings (instead of shipments) to industrial profits, consumer income, and the composite price of steel. This is the only study that indicates a substantial negative relation between the price of steel and steel bookings. The relationship might be even more pronounced if a more

[1] "Exhibit No. 1413," appendix, p. 13981 at 13993.

adequate representation of steel prices were used or if a lag of several months between price and volume were taken into account.

May I clarify these words with a chart containing these four relationships?

Mr. FELLER. Mr. Chairman, I offer the series of charts entitled "The Net Regression of Volume on Price."

(The chart referred to was marked "Exhibit No. 2187" and is included in the appendix on p. 14125.)

Mr. FELLER. As I understand it, these charts indicate analyses of data which was contained in the reports submitted by the United States Steel Corporation.

Dr. BEAN. Yes. They are the relationships which are given in one of the tables in the general report on demand for steel, with these stated in four different equations and summarized in a tabulation. Here we have plotted the equations and also the individual observations that are given in the study, so that we could observe whether or not the relationships as given by the equations are satisfactory.

With respect to the first equation, I find that it is necessary to make a slight alteration in the relation of industrial production to production of steel, getting a little more pronounced influence of industrial production on steel than is represented by the published equation, and when that slight alteration is made I find that the relation between price of steel and production is somewhat different from the one given by the equation. Instead of finding a positive relationship between price and production I find somewhat of a negative relationship merely as a result of improving in this analysis the relation of industrial production to steel production. We have here a negative relation of price to volume instead of the positive one found by the United States Steel Corporation analysts.

In the second equation there is given a positive relation of price to volume; the higher the price the larger the volume of steel production.

Note that there is just one point way outside of the range of the rest of the data which really controls the slope of that line, and by the mathematical method used that is correct. One point far removed from the body of the data controls the slope of this relationship.

Mr. FELLER. Pardon me, Dr. Bean, what is that point? I can't read it.

Dr. BEAN. 1920. The year 1920 in this analysis shows price of steel to have been very high as compared with the prices in all the other years subsequent to 1920. In the first equation that year was not used, therefore we found only a moderate slope of relation between price and volume, but the inclusion of that one year of very high prices necessarily shows a much greater influence of price on volume than was obtained in the other case, and you can readily see that if that one year were left out of the analysis all of the observations would be contained within a very limited area, and that it would be difficult to envision any kind of a relationship of price to volume.

If any importance is to be placed on this particular part of the analysis, you need to be aware of the fact that it is controlled almost entirely by one observation, that if that one observation were left out the result would be quite indefinite.

With respect to the third equation, I again find that the relation of price to volume is influenced to a large extent by two observations, in this case the years 1923 and 1937 that are considerably removed

from the area where the other price and volume data lie, and that if these 2 years were left out of the analysis, a much different result would be obtained within this elipse.

(Mr. O'Connell assumed the Chair.)

Mr. REYNDERS. May I ask what is the year of that low point?

Dr. BEAN. One is 1938, the other is 1934

Mr. REYNDERS. Does that practically balance the high?

Dr. BEAN. It does in this particular analysis; yes. By the mathematical method used here one point offsets the other and therefore you get a relatively insignificant influence of price on volume, but note that the result would be quite different if you leave out these 2 extraneous years.

Mr. REYNDERS. Can't you leave out the two in the lower ring?

Dr. BEAN. You may do that, but if you leave out these two, then the relationship takes on a steeper slope, which is more significant than the one contained in the report. If, as you suggest, you leave out also 1938 as an extraneous year or as one that doesn't belong in this analysis, then you still find that the relation of price to volume is greater than the one indicated here. For the group of years 1924, '25, '26, '27, '28, and '29, the relationship is not the one presented in the United States Steel Corporation report, but something of a greater slope, and if you deal similarly with the other years, 1930, '31, '32, '33, and '34, you again get a slope which is steeper than the one given by the published equation, so that accepting your suggestion that we leave out also 1938 as well as '23 and '37, I still find that the basic relationship as indicated by these data is something more significant than that given by the equation.

Finally, there is the fourth study where bookings are used instead of shipments or production, and here we do find a substantial relation of price to volume. The report indicates that the elasticity is 0.88, in other words a 10-percent increase in price associated with close to a 9-percent decrease in volume, or vice versa, and it is to me significant that the effect of price becomes more significant as these analyses come nearer to using more adequate data representing demand (in other words bookings is a more adequate measure of demand in a demand study than is the volume of production).

In general, it may be said that all of the foregoing analyses give such unreliable results that the authors themselves discard their showings as to the nature of elasticity of demand for steel and resort to the assumption of [illegible] elasticity as a basis for the further analyses of costs in relation to volume and of losses in relation to price reductions.

In their conclusions as to the effect of a given price reduction on the volume of steel, the authors of these studies fail to take into account the effect that such a price reduction would have on the general average of price of goods directly and indirectly affected by steel prices. They also fail to take into account the additional effect of the increased volume of steel due to a price reduction on business in general and therefore on steel, and that point Dr. Ezekiel elaborated yesterday. That there is a positive relation between steel activity is well known and demonstrated in these demand studies. They have not demonstrated the close relation that exists between the prices of iron and steel and the general level of prices of other goods. In the chart labeled "Indexes of prices of iron and steel and other commodity prices," this relationship is shown in a general way. While it is not

possible to indicate the effect of prices of iron and steel on other prices quantitatively—or of other prices on the prices of iron and steel—that effect nevertheless needs to be taken into account in any analyses of the relation of lower steel prices to volume and profits or losses.

And the chart that I just referred to, I would like to introduce into the record also.

Mr. FELLER. I offer for the record the chart entitled, "Index of Wholesale Prices of Iron and Steel and of Other Goods, for the years 1919 to 1938, inclusive."

Acting Chairman O'CONNELL. That will be admitted.

(The chart referred to was marked "Exhibit No. 2188" and is included in the appendix on p. 14126.)

Dr. BEAN. The source of these data, in the case of iron and steel, is the Bureau of Labor Index of Iron and Steel Prices, the other price index is derived from the Bureau of Labor series, the all-commodity index, by removing from it three groups—the group called farm products, the group called foods, and the third group, iron and steel; so that we have here a comparison annually between the fluctuations in the composite price of iron and steel and the composite of all other prices, exclusive of iron and steel and exclusive of the highly variable prices of foods and farm products.

By and large, there is a very close correspondence between these two price indexes, with two exceptions. One occurs in 1923, when iron and steel prices rose quite sharply, as contrasted with a fairly stable average for all other prices. I believe that the series introduced in the record by the Corporation the other day of mill net yields does not show quite this rise in steel prices for 1923. The other departure occurs after 1929, when the price of iron and steel remains at a relatively higher level than the prices of all other products, excluding iron and steel and the agricultural products.

But throughout these years, except for the fact of one index being at a higher level than the other, there is a very close correspondence in the year-to-year behavior, and I introduce this material for no other purpose than to suggest that the question of how much the price of iron and steel affects other prices has not been answered, and that it is something that ought to be fully looked into.

Mr. REYNDERS. There is a further divergence from last year, of course?

Dr. BEAN. Correct. In 1938, steel prices held at about the same level while prices of the other things, other than farm and food, which went down slightly.

Acting Chairman O'CONNELL. Any members of the committee have any questions?

Mr. WOODEN. Dr. Bean, you have used the expression "an inverse relationship between price and volume." I think we all understand what that means. In other words, as price decreases, the volume tends to increase. You have also used the expression of a negative relationship between price and volume. You don't mean the same thing by those two expressions, do you?

Dr. BEAN. Yes, I do. A line that rises to the right is, as a rule, called a positively inclined line, whereas one that declines to the right is called a negatively inclined line, and a negatively inclined line in this case is the same thing as showing an inverse relation between price and volume.

Mr. WOODEN. Is it your conclusion that there is this inverse relationship between the price of steel and the volume of steel sold, but sometimes that relationship is offset or overcome, or you might say reversed, by the strength of other factors?

Dr. BEAN. Yes, and that is true of practically all other prices, even agricultural prices.

Acting Chairman O'CONNELL. I believe there are no further questions at this time. Thank you very much, Dr. Bean.

Mr. FELLER. The next witness will be Dr. Yntema, recalled, who, as I understand, will comment on Dr. Bean's testimony.

TESTIMONY OF PROF. THEODORE OTTE YNTEMA, SCHOOL OF BUSINESS, UNIVERSITY OF CHICAGO, CHICAGO, ILL.—Resumed

Dr. YNTEMA. Mr. Chairman, I have just been listening with great interest, as I always do listen with great interest to any statement by Dr. Bean. He has been critical of some of the statistical work which we have done, and I shall be deeply critical of some of the suggestions which he has made. It should be made clear, however, that the area of our agreement is undoubtedly far greater than the area of our disagreement. I think that is a statement in which Dr. Bean himself will probably concur. This is just a matter of keeping a sense of proportion with respect to the criticisms that are offered.

In evaluating the analyses of demand which we submitted to the committee, Dr. Bean neglected almost entirely the main line of our argument, and concentrated his attention on the secondary evidence. In our studies we approached the problem of determining elasticity of demand by two general types of analysis. The first of these involves making a rough estimate of the elasticity of demand for some of the principal products made from steel, then the calculation of the proportion of steel cost to the price of these products, and finally the derivation from this evidence of the relative response in the quantity of steel sold to the price of steel in each of the respective industries producing these products.

This type of analysis is well known to economists, and as Dr. deChazeau indicated at one point in his testimony, leads unmistakably to the conclusion that the elasticity of demand for steel must be very low.

Dr. Bean has offered very little, if any, criticism of this type of analysis, which constitutes, I may say, the mainstay of our conclusions.

The second line of approach which we employed consisted in studying the relation of the quantity of steel purchased by the industry to the price of steel and other important variables determining its demand. As we shall indicate, some of his criticisms of this analysis are not of substantial validity, and at some points we think he has not quite fairly presented the statements which we have made.

I should like to emphasize that a considerable part of Dr. Bean's discussion has had to do with the gross or unadjusted relations (as he has taken care to point out) between changes in the price of steel and changes in its consumption in the automobile, container and railroad industries. This material which we presented was relatively unimportant and could have been dropped out entirely from the studies without impairing in any way their validity.

In criticizing this part of our studies, Dr. Bean has failed to understand the argument we were making, and I must say in fairness to him that we in turn ought to be criticized for failing to make our point clear. I think that the criticisms in this case are with reference to the lack of unambiguity on our part and not with reference to the content of the argument that we were trying to present.

Now, to get down to cases. In determining the demand for steel consumed by the automobile industry, we based our conclusions primarily upon the study of the demand for automobiles made by Roos and von Szeliski for General Motors Corporation and upon the proportion of the cost of steel to the retail price of an automobile.

To this major part of our argument, Dr. Bean has offered no objection whatsoever. Concentrating his attention on the relatively unimportant part of the analysis, he first quoted a portion of a sentence out of context, thereby distorting its meaning. Referring to chart 6 on page 19 of "Exhibit No. 1413"[1] entitled "An Analysis of the Demand for Steel in the Automobile Industry," he said that we claim that this scatter diagram showing percentage change in annual consumption and average annual price (which he has just exhibited to the committee) "fails to indicate that lower steel prices are associated with greater quantities of steel purchased and vice versa."

He then criticized us for failing to attempt to find from these data what the relationship between steel consumption and steel prices would have been if allowance had been made for the other factors. Let me read the sentence in its entirety:

> Since the scatter diagram fails to indicate that lower steel prices are associated with greater quantities of steel purchased and vice versa, it justifies the view that price considerations have a minor influence in determining the consumption of automobile steel.

That language is by no means clear. The idea we meant to convey was that, in the past, changes in the price of steel have not been the major determining influence, that they were offset or swamped, I think, was the phrase that Dr. Bean himself used, by the effect of other influences.

We should be the first to suggest that in the data there probably is some evidence of a negative relationship, that is, an inverse relationship, between changes in prices and changes in quantity, although the effect of the change in price upon the quantity bought is very slight indeed.

Taking these data in the scatter diagram, Dr. Bean has attempted to derive such a net relationship between price and quantity purchased by the automobile industry through the technique of graphic multiple correlation analysis, for the invention of which all statisticians are greatly indebted to him. It is generally recognized that this technique is one of the most powerful and also one of the most dangerous devices for analyzing data. Its application in this case illustrates both these characteristics.

At one point in his discussion, Dr. Bean uttered a profound truth. I quote:

> It is elementary in the statistical analyses that no reliable conclusions regarding the effect of one factor or another can be drawn unless the complicating influences of other factors known to be present have been isolated.

[1] Appendix, p. 13993.

This is a fundamental principle, absolutely essential to the application of the technique which he has used.

I suggest to you that Dr. Bean's analysis fails to reveal the true, underlying relationship between the price of steel and the consumption of steel in the automobile industry, because he has himself neglected important complicating factors which would have been apparent to him if he had been in position, and had had the opportunity, to give the problem more extended and intimate study.

If I may revert to the chart, I should like to suggest to you that Dr. Bean has either undertaken too little or too much. The inference that we intended to be drawn from this chart, entitled, "The Relation of Automobile Steel Price to Automobile Steel Consumption," appearing on page 19 of exhibit No. 1413, was simply that from the scatter of all of these observations showing changes in automobile steel consumption and changes in automobile steel price, it was not apparent that steel price was the controlling factor. Changes in steel prices were not the controlling factor in determining changes in automobile steel consumption. I think Dr. Bean would be the first to agree with that.

We merely meant to convey the idea—which we did not convey satisfactorily, as witness the fact that Dr. Bean misinterpreted us—we merely meant to convey this idea, that steel price is not the controlling factor, that there were other very important factors which he has himself recognized.

The procedure which Dr. Bean suggested is nothing new to us. We have spent many weary days trying to do what he has tried to do this morning. The difference between the procedure which he employed, however, and the procedure which we employed, is this, that we think he still failed to take into account many variables which are extremely important in this problem, and that the inferences which he draws from this chart consequently are not reliable.

For example, Dr. Bean said that it is possible to consider the relationship between changes in automobile steel consumption and automobile prices in the years 1933, 1935, and 1936, and the years preceding and from them, form some sort of a reasonable inference with respect to the net effect of changes in automobile steel price, upon automobile steel consumption. If I overstate the case, I hope that you will correct me, Dr. Bean.

He says that such a relationship may be inferred because in those years, the change in industrial production from the year preceding was of about the same level. Now, let me suggest to you that the change in industrial production is by no means the only important factor in this situation. For example, the change in consumer income from the year preceding is a far more important factor in changing the demand for automobile steel than changes in general industrial production.

A series of deflated consumer incomes, which I confess is none too satisfactory, exhibited the following characteristics: In 1933, there was a decrease in deflated consumer income of 3.6 percent; in 1935, an increase of 3.5 percent; and in 1936, an increase of 13.1 percent.

In the second place, the changes in the purchase of steel by the automobile industry reflect the increases or the decreases of their inventories. If you want to find the underlying relationship, neglecting changes in inventory, between the percentage change in price

and the percentage change in consumption, that factor is an extremely important one, particularly, I should say, in the year 1933, when we moved from a period of declining business to a period of advancing business.

In the third place, I should, for your consideration, point out the fact that Senator King so aptly cited a few minutes ago, and that is whether or not the change in psychological attitude on the part of those who buy automobiles and those who produce the automobiles, whether the changes in psychological attitude from the year preceding, in 1933 as compared with 1932, in 1935 as compared with 1934, and in 1936 as compared with 1935, were in fact the same. That happens to be a very important factor in the demand for automobiles and the demand for steel in the production of automobiles, and I submit to you that those changes were not in fact the same.

In the fourth place, the demand for automobiles and the demand for the steel in them depend upon the proportion of automobiles in existence which are about to be scrapped, and the changes in that situation from the year preceding. I should raise the question as to whether or not the change in that factor actually remained the same. I say there is some difference in that factor which ought not to be neglected.

There is still a further question that ought to be considered, whether or not the changes in the prices of other related products from 1932 to 1933, from 1934 to 1935, and from 1935 to 1936, were substantially the same, because those changes in the other prices are related to this net relationship which you are inclined to find between automobile steel consumption and automobile steel prices.

The reason we did not pursue this particular line of attack is that we did not have confidence in it. As I said before, I suggested to you that Dr. Bean has either tried to do too much or has done too little, because the only conclusion I would be willing to derive from this information presented to you this morning is that the price of steel is not the controlling force in determining the quantity of steel consumption; that it is swamped by other forces. I do not think that there would be substantial disagreement about that.

If you get into the study of net relationships, you are getting into exceedingly dangerous territory. We recognized that in the multiple correlation analysis, and we wrote page after page, pointing out the qualifications to which any such analysis must be subjected, and we used extreme care in making plain those qualifications.

In continuing with the discussion of the relation between the price of steel and its consumption in the automobile industry, Dr. Bean dealt with the problem of the variation in the steel consumed per automobile in relation to the price of steel. In attacking that particular problem, he employed data which we discarded because they were not applicable to the purpose. He took the reported figures on steel consumption in the industry and divided it by the number of cars, to obtain the average steel consumed per car. That neglects the effect of inventory changes in the hands of the automobile companies. We considered using the material and discarded it for that particular purpose because the data were not as satisfactory an indication of the steel per car as is obtained by the use of average weights per car. Those data appear on page 23 of "Exhibit No. 1413," and with reference to that particular set of materials, Dr. Bean has offered

no criticism whatever. I suggest to the committee that that is the appropriate study and the materials which he used are far less satisfactory for that purpose.

In dealing with the study of the demand for steel in the container industry, Dr. Bean did not go into such great detail and it is therefore not possible for me to offer such specific criticism of his comments. There are one or two points, however, that I do not think should be passed by without some comment.

He said:

> If we assume that the price of canned tomatoes is determined by supply, as measured by the size of the pack and by the price of tin plate, one of the important cost items, it is possible to observe both the nature of the relation of supply to price and of the relation of the price of tin plate to the price of a can of tomatoes.

Now, if you are considering the demand side of the situation, and you have the size of the pack, that is, the quantity of tomatoes packed to be sold, and that pack is sold, I cannot see, and I do not see, how anybody else could find that the price of tin plate is a relevant factor in determining the price of tomatoes. It is the quantity of tomatoes sold in the packed form that determines the price. The price of tin plate might be higher or lower but it would have no effect whatever upon the price of tomatoes. That is simply elementary economics.

Mr. REYNDERS. In that connection, could you refresh your memory as to what the fluctuation in the price of tin plate, what effect that would have on the price of a can of tomatoes?

Dr. YNTEMA. The evidence on that——

Mr. REYNDERS (interposing). I am speaking now of the fluctuation in price, not the price itself.

Dr. YNTEMA. The fluctuations in the price of tin plate were relatively small over this period, ranging from $5.50 to $4.43 per base box, a change of something in the neighborhood of 20 to 25 percent. The proportion of the cost of tin plate to the price of the goods sold at retail is about 10 percent. That would mean that the effect upon the final price of canned goods would be approximately 10 percent of the 25 percent, or in the neighborhood of 2 or 3 percent. That would be the effect which you would expect if it is passed on entirely to the consumer of the product.

May I revert again to one of Dr. Bean's charts? Dr. Bean presented this chart showing the price of tin plate and of canned goods, numbered "Exhibit No. 2186." This represents the price of tin plate from 1923 through 1938 and also the price of canned tomatoes, peas, and corn. I cannot quote Dr. Bean precisely in his comments on the chart, but if I understood him correctly, he conveyed the idea that this chart suggests that these fluctuations in the price of tin plate have been of some substantial importance in affecting the price of canned tomatoes, peas, and corn.

Now, Dr. Bean has pointed out at some length the importance of keeping constant the effect of other important variables, and it seems to me that it is not possible at all to draw any reliable conclusion from these two series unless we do exactly what he has told us we should do namely, allow for the effect of changes in the general price level and the national income, which also showed somewhat similar fluctuations during this period.

Acting Chairman O'CONNELL. If they did show somewhat similar variations, would it change the character of the relationship?

Dr. YNTEMA. It would make the answer indeterminable. I don't say that there is nothing whatsoever to Dr. Bean's suggestion; I simply say that it is incorrect statistical procedure, to infer, from the evidence which has been presented, that fact. If you did have the other evidence, the three series would move so much alike that the precision of any inference you could make would be far less than might appear upon a superficial examination of these data.

Dr. Bean said:

> In the studies on the demand for steel in the container, railroad and automobile industries, the relative unimportance of price is deduced from a set of scatter diagrams showing the relation between the year-to-year percentage changes in price of the appropriate kind of steel, and percentage changes in the factor which represents the use of steel by the particular industry.

Merely again to obtain the proper perspective, that was decidedly secondary evidence, and we did not deduce the relative importance from that evidence; we merely used that material to point out that other factors as well as price were of controlling importance in determining the quantity of steel bought by the various industries. Our analyses would not be one whit less convincing if that material were eliminated entirely from them. In fact, some criticis have told me that they think that our presentation would be improved by that omission. I think that is a fairly debatable point.

In general, then, summing up Dr. Bean's criticism of the use of these scatter diagrams, I suggest, first, that we have failed to make ourselves clear on them, that the point which we intended to convey is a perfectly proper point, but that we may perhaps have used not quite entirely unambiguous language, and if so, that fault is ours and we appreciate his calling it to our attention.

In the second place, we should deny that it is so easy to ascertain from inspection of these charts the sort of negative relationship which he has pointed out. The problem is far more complicated than he has made it. I suggest once more that either we must do more than he has indicated or otherwise, simply make the rough inference which we did make.

Finally, Dr. Bean offered some suggestions with reference to the analysis of the demand for steel by multiple correlation methods, and I should like to respond to them.

This net chart of Dr. Bean's is entitled, "The Net Regression of Volume on Price," and is numbered "Exhibit No. 2187."

The question might be raised, "Why did we incorporate in "Exhibit No. 1411" [1] a study showing a net relationship that as price goes up the average production and consumption of steel by all consuming industries increases."

The same question might be raised with respect to Relationship II. Now, we did not intend to convey to the committee or to anyone reading this report, that is "Exhibit No. 1411" (and I think that a simple reading of our text will indicate as much) that we thought that these relations, i. e., Relationships I and II in this exhibit, represented actually how consumption and production of steel would vary with price. The fact that we did present them ought to be taken as evidence of good faith, to show how difficult it is to find the true relationship by this method.

[1] Appendix, p. 13913.

Frankly, I should say that in Relationship I, as we have pointed out in the document entitled "A Statistical Analysis of the Demand for Steel, 1919–38," "Exhibit No. 1411", we think that we have not taken entirely satisfactory variables into account.

In that particular study we investigated the relationship between the fluctuation of production of steel ingots and castings and the price of steel and industrial production and a time trend. The inference to be drawn from this study is that price of steel, industrial production, and time trend do not account with entire satisfaction for the production of steel ingots and castings. It is a cardinal principle in statistics that when your results don't make sense you discard them. In this particular case I should say that the results do not conform entirely with expectations and that the analysis must therefore be carried further.

Mr. LEWIS.[1] In both of these relationships we very carefully pointed out in "Exhibit No. 1411" that the basic data on which they were computed were inadequate for drawing any conclusion from them, and we ourselves did not draw any conclusions from them. In several pages we pointed out that steel ingot production was not a satisfactory measure of steel sales, nor was industrial production, on the other hand, a satisfactory measure of the shifts in demand assuming price constant.

Dr. YNTEMA. From our own report, "Exhibit No. 1411" therefore, you can read without difficulty that we did not attach great significance to this finding. It would have made a far better appearing report if we had simply omitted this entirely (referring to Relationships I and II) and presented just one result. We elected, however, to show to the committee what was involved in this sort of study and to give some idea of the qualifications which must be kept in mind in interpreting it.

The point that Dr. Bean has raised with respect to Relationship II in this "Exhibit No. 2187" [2] is certainly correct, that the slope of this line representing how production fluctuates in relation to the composite price of finished steel is determined largely by this one observation for 1920, and no statistician would therefore attach great weight to it. We did not attach any great significance either to this particular finding.

In Relationship III we find that the average behavior of shipments of steel in relation to price is such that as price goes up shipments go down. Dr. Bean has suggested that if we eliminate two observations 1937 and 1923, from this Relationship III, that the average line of relationship would be steeper. Well, that of course is no basis for statistical procedure. Merely because two points fail to conform to the others is no basis for eliminating those points. If there were a sound logical reason for eliminating those two particular points, then their elimination ought to be considered, but it is one of the worst types of statistical manipulation to omit points merely because they happen to fail to conform to the rest of the observations.

May I suggest this, please. I am not accusing Dr. Bean of poor statistical technique. Dr. Bean is one of the best statisticians whose acquaintance it is my pleasure to have made. I am merely suggesting that Dr. Bean's point is a good one that you ought to investigate whether there is some characteristic which those points have, and I

[1] Harold Gregg Lewis, economist, University of Chicago. See supra, p. 13650.
[2] Appendix, p. 14125.

think that that should be taken into account in going further with the analysis.

Mr. LEWIS. May I interrupt? In the first place, Dr. Bean has said that if we actually eliminated these two observations we should get a net relationship between price and volume, which would be approximately three times as large as the one we actually obtained. Of course even if we did that, our result would still be significantly less than unit elasticity. Even if we eliminated these points, the final conclusion we would get would be that changes in steel price do not lead to larger proportional changes in steel volume. Actually, since this report [1] was written—unfortunately Dr. Bean has not had an opportunity to study the data in the same way that we have—I have attempted to account for the fact that these observations, 1937, 1923, 1924, 1938, 1933, are extreme observations. I have found that if we include additional factors such as the rate of change in the price of steel, that is, essentially, if we study speculative buying of steel, that these points lie very close to this line. Not only is that true, but our results lead us to the conclusion that actually the elasticity we should so obtain would be lower than the elasticities which were obtained in this report.

Dr. Bean's major comment on this last relationship in which steel bookings are related to composite price of steel, industrial profits, and consumer income, is that first we have probably used an inadequate measure of price. I do not quite understand what criticism he has of that price. However, may I point out that since this computation was made, we have actually used the index of mill yet yield, which is a very carefully constructed mill net index, and we have found if we substituted that index for the price we used in the report, entitled "A Statistical Analysis of the Demand for Steel, 1919–38", "Exhibit No. 1411," that our results would not be changed significantly.

Secondly, he has suggested in connection with this last relationship that if we lag price or consumption, we should probably get a somewhat different result. I should agree with that, but in order to demonstrate the reasonableness of such a lag, he should have to give some underlying logic whereby that lag could be given some definite economic meaning.

Dr. YNTEMA. May I offer in conclusion just a few remarks? The area of agreement is far greater than that of disagreement, and Dr. Bean and I, I am sure, do not have substantially different views in these matters, and I want to emphasize this point, that part of the difficulty has arisen due to our own fault in not making perfectly clear what we intended to show.

There is one point to which Dr. Bean reverted in concluding his testimony with respect to our alleged failure to take into account the additional effect of the increased volume of steel, due to a price reduction, on business in general, and, therefore, on steel. This is the same point that Dr. Ezekiel made yesterday, and since we are to discuss Dr. Ezekiel's statement tomorrow, I should like to defer comment on this particular point until that time.

Acting Chairman O'CONNELL. I would like to recess now. What is your pleasure?

Mr. FELLER. Dr. Bean wanted to make one observation.

Dr. BEAN. Just two comments. I do not believe I was unfair in the quotation from "Exhibit No. 1413" that I cited in respect to

[1] "Exhibit No. 1411", appendix, p. 13913.

chart 6 of that exhibit.[1] If any of you will read it, leave off the word "since," and the last phrase in that sentence, and you will get the gist of what the authors apparently had in mind. I tried to find their thought. The only place where I could find it was in that particular sentence to which they have added the word "since," and I don't think the word "since" alters the meaning of that sentence.

The second point, as to whether or not this material has been presented to the committee in such a way as to leave with the committee a full understanding of the complications, the inadequacies and all the rest. It is my impression that the reports do not quite do that job, and I turn for the moment to page 28 [2] of the "Analysis of the Demand for Steel" ("Exhibit No. 1411") reading next to the last paragraph on that page: "In the graphical analyses that were made of the various demand relations, there were clear indications that if the lags of shipments and industrial profits behind bookings were removed, Relations III and IV would both give about the same results for the elasticity of demand, yielding a figure of 0.3 to 0.4." It is the next sentence I really have in mind. "The evidence and argument adduced in the preceding pages of this paper support the conclusion that such a value—or one even lower—for the elasticity of demand for steel is not a statistical happenstance, but a reality."

I would underscore the word "reality." It is my impression that this particular paragraph which will be generally read—if anything is read in these reports it will be paragraphs of that sort and not the equations and not the qualifications—gives much greater importance to the analyses contained in these reports than I think the analyses are entitled to. Finally, if these analyses are not entitled to be taken with a great deal of reliability, then I would say to Dr. Yntema that they should not have been included with the implication that they corroborate his basic conclusions.

Dr. YNTEMA. May I comment? I think we all owe a debt of gratitude to Dr. Bean for bringing out more clearly in the discussion considerations which ought to be kept in mind in evaluating the evidence. I should like to call his attention to a word in the sentence which he read. This sentence begins, "The evidence and argument"—If I had used as the subject of that sentence "statistical analyses", without any logical argument accompanying it, I should never have stated that conclusion. The reason why we concluded that the low elasticity demand for steel is not a statistical happenstance but a reality is that it "made sense."

Mr. FELLER. Mr. Chairman, before we adjourn, and I suggest that we adjourn until 10:30 tomorrow morning, I should like to express on behalf of Dr. Kreps his profound gratitude to the Steel Corporation, to Dr. Yntema, to his staff, and to Drs. deChazeau, Taitel, Ezekiel, and Bean for their work in bringing out this important material. On behalf of myself I should like to make just one observation. Ever since I heard of the science of econometrics, I have been very skeptical of it. After listening to the most eminent practitioners of that science or art, my skepticism has not been substantially lessened. Mr. Justice Holmes once said that a page of history is worth a volume of logic, and after listening to the discussion here, I wondered whether

[1] Appendix p. 13993.
[2] Of the original document.

it couldn't be paraphrased by saying a page of business facts is worth a volume of econometrics.

Acting Chairman O'CONNELL. I think that the committee has the same view that you do as to paying our tribute to Dr. Yntema and his staff for the work they have done, and on behalf of the committee, I also want to thank Dr. deChezeau, Dr. Ezekiel, Dr. Bean, and Mr. Taitel for the work they did in helping to present this rather complicated picture to the committee.

We will recess now until 10:30 tomorrow morning.

(Whereupon at 12:25 p. m., the committee recessed until 10:30 a. m., Friday, January 26, 1940.)

(Testimony on the Iron and Steel Industry is resumed and concluded in Hearings, Part 27.)

APPENDIX

The following exhibits, Nos. 1409 to 1418, were introduced and ordered to be placed on file with the committee during Hearings, Part 20. They were subsequently ordered to be printed and are reproduced herewith, with the exception of "Exhibit No. 1418," which is included in Hearings, Part 27.

Exhibit No. 1409

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SECTION A—FINANCIAL

Title of Chart

SECTION B—COSTS

SECTION C—PRICES

Title of Chart

Composite Mill Net Yield and Cost per Weighted Ton Shipped (1926=100)
Average Yearly Base Prices of Principal Steel Products (1924=100)
Reported Base Price and Mill Net Yield:
- Heavy Structural Shapes at Pittsburgh
- Heavy Structural Shapes at Chicago
- Plates at Pittsburgh
- Bars at Pittsburgh
- Bars at Chicago
- Standard Pipe at Pittsburgh
- Cold Rolled Sheets

Reported Composite Price and Composite Mill Net Yield (1926=100):
- From 1926
- From 1912

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Flow Chart of Steelmaking

SECTION A—FINANCIAL

Assets—U. S. Steel Corporation and subsidiaries

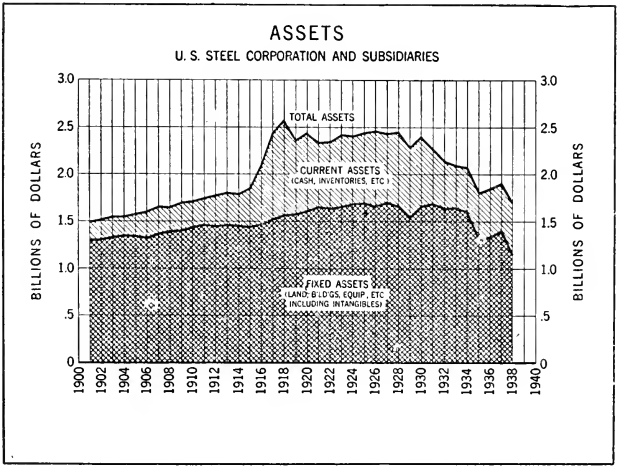
Year	Fixed Assets (Land, Buildings, Equipment, Etc.)	Current Assets (Cash, Inventories, Etc.)	Total Assets
1901	$1, 291, 883, 833	$190, 644, 992	$1, 482, 528, 825
1902	1, 300, 521, 858	211, 276, 652	1, 511, 798, 510
1903	1, 328, 132, 137	216, 079, 027	1, 544, 211, 164
1904	1, 336, 882, 848	207, 929, 556	1, 544, 812, 404
1905	1, 330, 097, 766	242, 355, 569	1, 572, 453, 335
1906	1, 320, 077, 668	279, 237, 763	1, 599, 315, 431
1907	1, 372, 972, 818	284, 366, 811	1, 657, 339, 629
1908	1, 393, 522, 329	243, 539, 140	1, 637, 061, 469
1909	1, 401, 507, 849	290, 920, 288	1, 692, 428, 137
1910	1, 430, 212, 861	281, 806, 984	1, 712, 019, 845
1911	1, 460, 303, 983	278, 984, 551	1, 739, 288, 534
1912	1, 448, 175, 255	327, 324, 854	1, 775, 500, 109
1913	1, 465, 498, 632	335, 087, 691	1, 800, 586, 323
1914	1, 457, 853, 930	334, 379, 563	1, 792, 233, 493
1915	1, 443, 300, 766	405, 241, 095	1, 848, 541, 861
1916	1, 472, 623, 667	610, 404, 307	2, 083, 027, 974
1917	1, 521, 836, 792	927, 713, 414	2, 449, 550, 206
1918	1, 563, 937, 123	007, 680, 052	2, 571, 617, 175
1919	1, 573, 661, 547	792, 220, 835	2, 365, 882, 382
1920	1, 606, 758, 546	823, 788, 417	2, 430, 546, 963
1921	1, 644, 795, 075	694, 310, 235	2, 339, 105, 310
1922	1, 631, 579, 206	709, 074, 010	2, 340, 653, 216
1923	1, 639, 158, 642	781, 724, 062	2, 420, 882, 704
1924	1, 678, 208, 569	735, 986, 097	2, 414, 194, 666
1925	1, 692, 197, 704	753, 445, 627	2, 445, 643, 331
1926	1, 667, 391, 498	786, 747, 687	2, 454, 139, 185
1927	1, 709, 779, 732	723, 803, 437	2, 433, 583, 169
1928	1, 661, 123, 969	780, 906, 264	2, 442, 030, 233
1929	1, 541, 492, 587	744, 691, 068	2, 286, 183, 655
1930	1, 677, 327, 334	717, 217, 277	2, 394, 544, 611
1931	1, 683, 982, 093	595, 820, 720	2, 279, 802, 813
1932	1, 650, 816, 309	507, 915, 913	2, 158, 732, 222
1933	1, 653, 923, 749	448, 973, 131	2, 102, 896, 880
1934	1, 626, 143, 782	457, 968, 505	2, 084, 112, 287
1935	1, 338, 522, 859	483, 878, 883	1, 822, 401, 742
1936	1, 350, 037, 282	513, 939, 237	1, 863, 976, 519
1937	1, 410, 432, 914	508, 296, 375	1, 918, 729, 289
1938	1, 166, 519, 513	544, 759, 493	1, 711, 279, 006

Data are as shown on books at the end of each year. Data for 1901 are partially estimated
Fixed assets include good will and other intangible items, as well as tangible property.
All property values are "net," after the deduction of reserves for depletion, depreciation, etc.
Current assets include a relatively small amount of other assets, e. g., mining royalties, deferred charges, etc. Inter-company profit in inventories has been eliminated from current assets.

Assets—1938 compared with 1901—U. S. Steel Corporation and subsidiaries

	1901 (April 1st)	1938 (December 31st)
Land, Buildings, Equipment, etc	$545, 500, 000	$1, 166, 519, 512
Intangibles	749, 207, 806	1
Current Assets	194, 694, 676	544, 759, 493
Total	$1, 489, 402, 482	$1, 711, 279, 006

Allocation of fixed assets in 1901, as between land, buildings, equipment, etc., and intangibles, is that of U. S. Bureau of Corporations made in 1911.



While fixed assets of U. S. Steel Corporation are now carried on the books at less than the value of fixed assets at the time of the organization in 1901, the Corporation's physical plant is much greater today. This largely results from two causes:

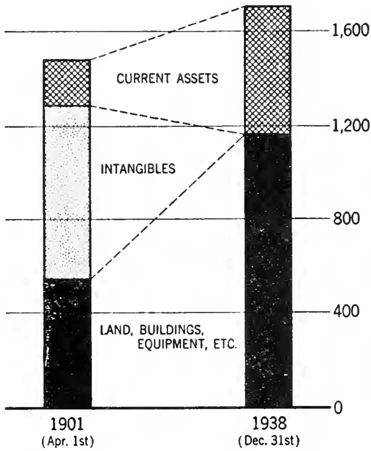
(1) The elimination from time to time of all intangible values. When the Corporation was formed, various going businesses were acquired at prices in excess of the value of their tangible property, resulting in intangible assets of about $750,000,000 (as later determined by the U. S. Bureau of Corporations), representing the good-will or earning power of these businesses. While originally of real value, it has been deemed prudent to write-down from time to time the value of all such intangible items, good-will now being valued at $1.00.

(2) The reserve for obsolescence and depreciation was increased to the extent of $270,000,000 in 1935, principally because of improvements in manufacturing methods which made existing facilities of older design less valuable.

ASSETS - 1938 COMPARED WITH 1901

U. S. STEEL CORPORATION AND SUBSIDIARIES

MILLIONS OF DOLLARS



ASSETS OF THE CORPORATION ARE CONSERVATIVELY VALUED

1. Values of property are based on reports of Departments of U. S. Government
2. Property was certified to be conservatively valued by independent engineers as of Dec. 31, 1937
3. Intangible values have been written down to $1

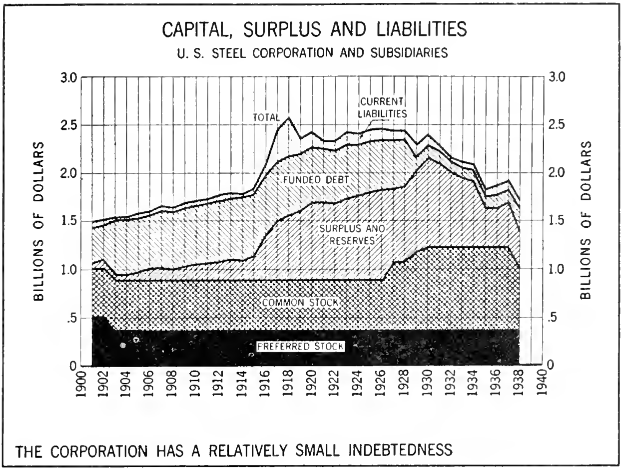
The amount of intangibles originally included in the property account of U. S. Steel Corporation at its organization on April 1, 1901 represented the good will or earning power of the various going businesses, which were consolidated to form the Corporation, over and above the value of their tangible assets. This amount has been written off from time to time and was finally reduced to $1.00 in 1938.

Of the total of nearly $750,000,000 of intangibles, $182,000,000 was written off against current earnings, $285,000,000 against capital surplus, and the remainder against earned surplus.

Capital, surplus and liabilities—U. S. Steel Corporation and subsidiaries

Year	Preferred Stock	Common Stock	Surplus and Reserves	Funded Debt	Current Liabilities	Total
1901	$510, 205, 743	$508, 227, 394	$29, 550, 140	$380, 365, 830	$54, 179, 718	$1, 482, 528, 825
1902	510, 281, 100	508, 302, 500	72, 827, 866	370, 560, 792	49, 826, 252	1, 511, 798, 510
1903	360, 281, 100	508, 302, 500	61, 956, 410	574, 130, 514	39, 540, 640	1, 544, 211, 164
1904	360, 281, 100	508, 302, 500	60, 048, 347	576, 342, 203	39, 838, 254	1, 544, 812, 404
1905	360, 281, 100	508, 302, 500	89, 595, 628	573, 506, 549	40, 767, 558	1, 572, 453, 335
1906	360, 281, 100	508, 302, 500	120, 648, 046	566, 411, 776	43, 672, 009	1, 599, 315, 431
1907	360, 281, 100	508, 302, 500	137, 351, 182	606, 341, 022	45, 063, 825	1, 657, 339, 629
1908	360, 281, 100	508, 302, 500	127, 412, 522	598, 033, 493	43, 031, 854	1, 637, 061, 469
1909	360, 281, 100	508, 302, 500	152, 932, 904	609, 766, 907	61, 144, 726	1, 692, 428, 137
1910	360, 281, 100	508, 302, 500	190, 531, 446	600, 070, 012	52, 834, 787	1, 712, 019, 845
1911	360, 281, 100	508, 302, 500	196, 817, 873	622, 251, 002	51, 636, 059	1, 739, 288, 534
1912	360, 281, 100	508, 302, 500	201, 966, 918	644, 538, 723	60, 410, 868	1, 775, 500, 109
1913	360, 281, 100	508, 302, 500	235, 872, 934	637, 552, 728	58, 577, 061	1, 800, 586, 323
1914	360, 281, 100	508, 302, 500	220, 679, 690	661, 102, 374	41, 867, 829	1, 792, 233, 493
1915	360, 281, 100	508, 302, 500	271, 071, 558	644, 052, 373	64, 834, 330	1, 848, 541, 861
1916	360, 281, 100	508, 302, 500	491, 698, 022	629, 803, 916	92, 942, 436	2, 083, 027, 974
1917	360, 281, 100	508, 302, 500	617, 577, 414	623, 037, 609	340, 351, 583	2, 449, 550, 206
1918	360, 281, 100	508, 302, 500	687, 607, 253	617, 644, 840	397, 781, 482	2, 571, 617, 175
1919	360, 281, 100	508, 302, 500	738, 017, 793	602, 209, 725	157, 071, 264	2, 365, 882, 382
1920	360, 281, 100	508, 302, 500	818, 406, 123	586, 812, 045	156, 745, 195	2, 430, 546, 963
1921	360, 281, 100	508, 302, 500	813, 758, 392	572, 514, 762	84, 248, 556	2, 339, 105, 310
1922	360, 281, 100	508, 302, 500	801, 560, 015	571, 756, 017	98, 753, 584	2, 340, 653, 216
1923	360, 281, 100	508, 302, 500	856, 910, 754	557, 985, 323	137, 403, 027	2, 420, 882, 704
1924	360, 281, 100	508, 302, 500	882, 163, 430	540, 488, 518	122, 959, 118	2, 414, 194, 666
1925	360, 281, 100	508, 302, 500	922, 177, 402	537, 964, 166	116, 918, 163	2, 445, 643, 331
1926	360, 281, 100	508, 302, 500	944, 859, 235	519, 574, 424	121, 121, 926	2, 454, 139, 185
1927	360, 281, 100	711, 623, 500	752, 226, 629	500, 529, 307	108, 922, 633	2, 433, 583, 169
1928	360, 281, 100	711, 623, 500	777, 180, 077	480, 429, 556	112, 516, 000	2, 442, 030, 233
1929	360, 281, 100	813, 284, 000	848, 811, 007	134, 788, 423	129, 019, 125	2, 286, 183, 655
1930	360, 281, 100	868, 743, 500	925, 487, 442	123, 054, 594	116, 977, 975	2, 394, 544, 611
1931	360, 281, 100	870, 325, 200	864, 810, 665	119, 063, 247	65, 322, 601	2, 279, 802, 813
1932	360, 281, 100	870, 325, 200	764, 707, 681	114, 921, 210	48, 497, 031	2, 158, 732, 222
1933	360, 281, 100	870, 325, 200	706, 870, 895	110, 398, 829	55, 020, 856	2, 102, 896, 880
1934	360, 281, 100	870, 325, 200	679, 719, 257	117, 496, 363	56, 290, 367	2, 084, 112, 287
1935	360, 281, 100	870, 325, 200	408, 023, 691	114, 240, 603	69, 531, 148	1, 822, 401, 742
1936	360, 281, 100	870, 325, 200	411, 969, 078	117, 843, 431	103, 557, 710	1, 863, 976, 519
1937	360, 281, 100	870, 325, 200	445, 083, 957	125, 707, 961	117, 331, 071	1, 918, 729, 289
1938	360, 281, 100	652, 743, 900	370, 143, 288	248, 849, 388	79, 261, 330	1, 711, 279, 006

Data are as shown on books at the end of each year. Data for 1901 are partially estimated.
Premiums on common stock sold are included with surplus.
Surplus is exclusive of inter-Company profit in inventories.
Reserves do not include depreciation, depletion and amortization reserves, which are applied to the credit of gross property investment.
Purchase money obligations and minority interest are included with funded debt.



U. S. Steel Corporation has a sound financial structure, with a relatively small amount of liabilities and a comparatively large amount of surplus and reserves, and capital stock. Present capitalization is represented entirely by tangible assets.

A large part of the funded debt was retired in 1929, resulting in substantial reduction in fixed charges further fortifying the Corporation against business depressions.

The decrease in surplus and reserves since 1930 reflects depression period losses, the increase in reserve for obsolescence and depreciation in 1935, and the write-down to $1.00 of the intangibles remaining in 1938.

The increase in common stock in 1927 was the result of a 40% stock dividend, that in 1929 was due to the sale of additional common stock for cash, and that in 1930 was in connection with property acquisitions, viz., Atlas Portland Cement Company, Oil Well Supply Company and Columbia Steel Corporation; the decrease in 1938 was due to the change in the common stock from $100 par value to no par value, with a stated capital of $75 per share.

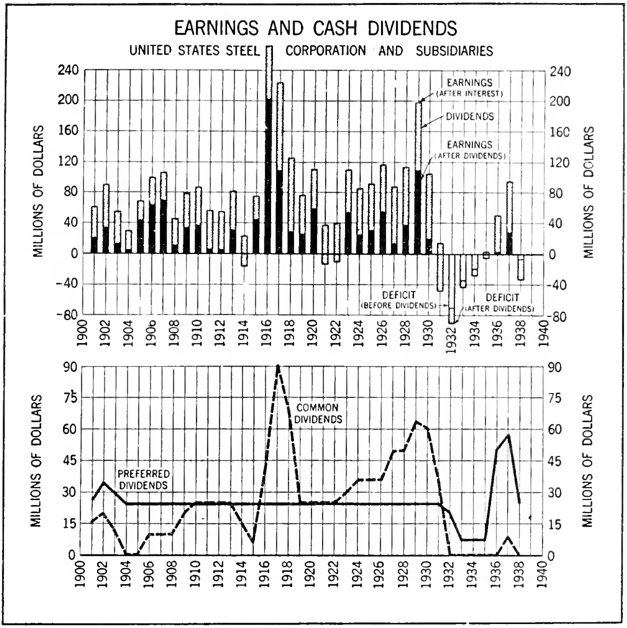
Earnings and cash dividends—U. S. Steel Corporation and subsidiaries

Year	Earnings (After Interest)	Earnings (After Common and Preferred Dividends	Preferred Dividends	Common Dividends	Total Cash Dividends
1901	$61,807,993	$19,828,824	$26,752,539	$15,226,630	$41,979,169
1902	90,306,525	34,253,657	35,720,178	20,332,690	56,052,868
1903	55,416,653	12,304,917	30,404,173	12,707,563	43,111,736
1904	30,267,529	5,047,852	25,219,677	----------	25,219,677
1905	68,585,492	43,365,815	25,219,677	----------	25,219,677
1906	98,128,587	62,742,860	25,219,677	10,166,050	35,385,727
1907	104,565,564	69,179,837	25,219,677	10,166,050	35,385,727
1908	45,728,714	10,342,987	25,219,677	10,166,050	35,385,727
1909	79,073,695	33,521,918	25,219,677	20,332,100	45,551,777
1910	87,407,185	36,772,383	25,219,677	25,415,125	50,634,802
1911	55,300,297	4,665,495	25,219,677	25,415,125	50,634,802
1912	54,240,049	3,605,247	25,219,677	25,415,125	50,634,802
1913	81,216,986	30,582,184	25,219,677	25,415,125	50,634,802
1914	23,496,768	[1] 16,971,984	25,219,677	15,249,075	40,468,752
1915	75,833,832	44,260,374	25,219,677	6,353,781	31,573,458
1916	271,531,731	201,835,585	25,219,677	44,476,469	69,696,146
1917	224,219,564	107,505,437	25,219,677	91,494,450	116,714,127
1918	125,317,377	28,935,350	25,219,677	71,162,350	96,382,027
1919	76,794,582	26,159,780	25,219,677	25,415,125	50,634,802
1920	109,694,228	59,059,426	25,219,677	25,415,125	50,634,802
1921	36,617,017	[1] 14,017,785	25,219,677	25,415,125	50,634,802
1922	39,653,455	[1] 10,981,347	25,219,677	25,415,125	50,634,802
1923	108,707,065	54,259,994	25,219,677	29,227,394	54,447,071
1924	85,067,192	24,266,340	25,219,677	35,581,175	60,800,852
1925	90,602,653	29,801,801	25,219,677	35,581,175	60,800,852
1926	116,667,405	55,866,553	25,219,677	35,581,175	60,800,852
1927	87,896,836	12,863,514	25,219,677	49,813,645	75,033,322
1928	114,173,775	39,140,453	25,219,677	49,813,645	75,033,322
1929	197,592,060	108,523,343	25,219,677	63,849,040	89,068,717
1930	104,421,571	18,836,097	25,219,677	60,365,797	85,585,474
1931	13,038,142	[1] 49,165,485	25,219,677	36,983,950	62,203,627
1932	[1] 71,175,705	[1] 91,891,868	20,716,163	----------	20,716,163
1933	[1] 36,501,123	[1] 43,706,745	7,205,622	----------	7,205,622
1934	[1] 21,667,780	[1] 28,873,402	7,205,622	----------	7,205,622
1935	1,146,708	[1] 6,058,914	7,205,622	----------	7,205,622
1936	50,583,356	144,002	50,439,354	----------	50,439,354
1937	94,944,358	27,695,427	58,545,679	8,703,252	67,248,931
1938	[1] 7,717,454	[1] 32,937,131	25,219,677	----------	25,219,677

[1] Indicates loss.

Earnings are after all charges, including interest, bond premium and discount, all taxes, and additions to bond sinking funds which were later applied to amortization of intangibles.

Earnings would be slightly lower if the special addition to depreciation reserve of $270,000,000 in 1935 could be accurately apportioned over prior years.



U. S. Steel Corporation earnings and cash dividends on the common stock have fluctuated greatly since 1901.

Since 1930, earnings have been insufficient to cover preferred dividend requirements in all but two years. Less than the full amount of the preferred dividend was paid in each of the years 1932-1935, inclusive, and the accumulated arrearages were paid off from the earnings of 1936 and 1937

The common stock has received no dividend since 1931, with the exception of $1.00 per share paid in 1937.

Earnings and cash dividends per share of common stock—United States Steel Corporation

Year	Earnings per Share of Common Stock	Cash Dividends per Share of Common Stock	Year	Earnings per Share of Common Stock	Cash Dividends per Share of Common Stock
1901	$6.90	$3.00	1920	$16.62	$5.00
1902	10.74	4.00	1921	2.24	5.00
1903	4.92	2.50	1922	2.84	5.00
1904	.99		1923	16.42	5.75
1905	8.53		1924	11.77	7.00
1906	14.34	2.00	1925	12.86	7.00
1907	15.61	2.00	1926	17.99	7.00
1908	4.03	2.00	1927	10.28	7.00
1909	10.59	4.00	1928	12.50	7.00
1910	12.23	5.00	1929	22.61	8.00
1911	5.92	5.00	1930	9.42	7.00
1912	5.71	5.00	1931	[1] 1.40	4.25
1913	11.02	5.00	1932	[1] 11.08	
1914	[1] .34	3.00	1933	[1] 7.09	
1915	9.96	1.25	1934	[1] 5.39	
1916	48.46	8.75	1935	[1] 2.77	
1917	39.15	18.00	1936	2.91	
1918	19.69	14.00	1937	8.01	1.00
1919	10.15	5.00	1938	[1] 3.78	

[1] Indicates loss.

Earnings data used are the consolidated earnings of U. S. Steel Corporation and subsidiaries after all charges, including interest, bond premium and discount, all taxes, and additions to bond sinking funds which were later applied to amortization of intangibles.

Earnings would be slightly lower if the special addition to depreciation reserve of $270,000,000 in 1935 could be accurately apportioned over prior years.

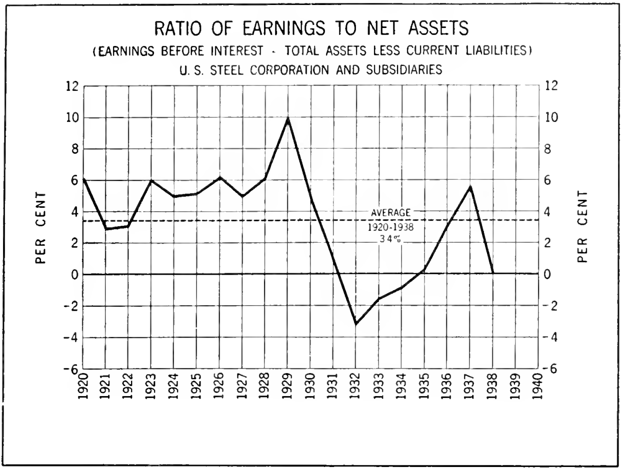
Calculation of earnings per share is based upon average of common shares outstanding at beginning and end of year; earnings are after preferred dividend requirement, regardless of amount paid.

Ratio of earnings to net assets—U. S. Steel Corporation and subsidiaries

Year	Earnings (Before Interest)	Net Assets (Assets less Current Liabilities)	Ratio of Earnings to Net Assets (Percent)
1920	$139,043,581	$2,273,801,768	6.12
1921	65,109,283	2,254,856,754	2.89
1922	68,020,445	2,241,899,632	3.03
1923	136,718,703	2,283,479,677	5.99
1924	112,377,701	2,291,235,548	4.90
1925	117,711,771	2,328,725,168	5.05
1926	143,425,343	2,333,017,257	6.15
1927	113,960,340	2,324,660,536	4.90
1928	139,919,784	2,329,514,233	6.01
1929	212,536,930	2,157,164,530	9.85
1930	110,061,667	2,277,566,636	4.83
1931	18,507,766	2,214,480,212	0.84
1932	[1] 65,862,244	2,110,235,191	[1] 3.12
1933	[1] 31,336,670	2,047,876,024	[1] 1.53
1934	[1] 16,616,728	2,027,821,920	[1] 0.82
1935	6,106,488	1,752,870,594	0.35
1936	55,501,787	1,760,418,809	3.15
1937	100,085,446	1,801,398,218	5.56
1938	544,874	1,632,017,676	0.03

[1] Indicates loss.

Earnings are before interest but after all other charges, including all taxes.



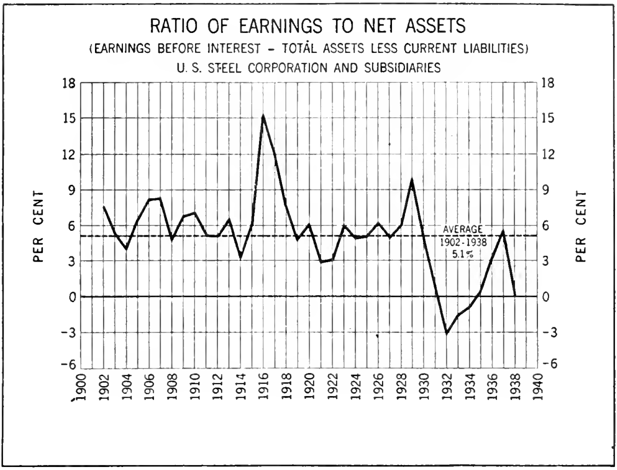
Since 1920, the ratio of earnings of U. S. Steel Corporation to the combined investment of stockholders and bondholders has averaged approximately 3.4%. For the past ten years the ratio has been slightly less than 2%.

Ratio of earnings to net assets—U. S. Steel Corporation and subsidiaries

Year	Earnings (Before Interest)	Net Assets (Assets less Current Liabilities)	Ratio of Earnings to Net Assets (Percent)
1902	$111, 607, 959	$1, 461, 972, 258	7. 63
1903	81, 053, 310	1, 504, 670, 524	5. 39
1904	60, 358, 968	1, 504, 974, 150	4. 01
1905	98, 352, 144	1, 531, 685, 777	6. 42
1906	127, 529, 916	1, 555, 643, 422	8. 20
1907	133, 918, 112	1, 612, 275, 804	8. 31
1908	76, 992, 566	1, 594, 029, 615	4. 83
1909	110, 678, 167	1, 631, 283, 411	6. 78
1910	118, 037, 399	1, 659, 185, 058	7. 11
1911	86, 444, 915	1, 687, 652, 475	5. 12
1912	86, 809, 249	1, 715, 089, 241	5. 06
1913	114, 518, 267	1, 742, 009, 262	6. 57
1914	56, 728, 289	1, 750, 365, 664	3. 24
1915	108, 587, 831	1, 783, 707, 531	6. 09
1916	303, 574, 450	1, 990, 085, 538	15. 25
1917	255, 209, 008	2, 109, 198, 623	12. 10
1918	168, 191, 734	2, 173, 835, 693	7. 74
1919	106, 938, 932	2, 208, 811, 118	4. 84
1920	139, 043, 581	2, 273, 801, 768	6. 12
1921	65, 109, 283	2, 254, 856, 754	2. 89
1922	68, 020, 445	2, 241, 899, 632	3. 03
1923	136, 718, 703	2, 283, 479, 677	5. 99
1924	112, 377, 701	2, 291, 235, 548	4. 90
1925	117, 711, 771	2, 328, 725, 168	5. 05
1926	143, 425, 343	2, 333, 017, 257	6. 15
1927	113, 960, 340	2, 324, 680, 536	4. 90
1928	139, 919, 784	2, 329, 514, 233	6. 01
1929	212, 536, 930	2, 157, 164, 530	9. 85
1930	110, 061, 667	2, 277, 566, 636	4. 83
1931	18, 507, 766	2, 214, 180, 212	0. 84
1932	[1] 65, 862, 244	2, 110, 235, 191	[1] 3. 12
1933	[1] 31, 336, 670	2, 047, 876, 024	[1] 1. 53
1934	[1] 16, 616, 728	2, 027, 821, 920	[1] 0. 82
1935	6, 106, 488	1, 752, 870, 594	0. 35
1936	55, 501, 787	1, 760, 418, 809	3. 15
1937	100, 085, 446	1, 801, 398, 218	5. 56
1938	544, 874	1, 632, 017, 676	0. 03

[1] Indicates loss.

Earnings are before interest but after all other charges, including all taxes.



Since organization, the ratio of earnings of U. S. Steel Corporation to the combined investment of stockholders and bondholders has averaged approximately 5.1%; since 1920, the ratio has been about 3.4%; and for the past ten years the ratio has been slightly less than 2%.

Distribution of the sales dollar—1929-1938 inclusive—U. S. Steel Corporation and subsidiaries

Classification	Dollar Amount	Per Cent of Sales
Payroll (Wages and Salaries)	$2,804,198,490	42.8
Goods and Services Purchased from Others	2,379,954,228	36.4
Depreciation and Depletion	512,132,759	7.8
Taxes (Federal, State and Local)	464,685,657	7.1
Bond Interest (Including Premium and Discount)	64,865,182	1.0
Dividends on Preferred Stock	252,196,770	3.8
Available for Dividends on Common Stock	72,467,364	1.1
Sales and Other Revenues	$6,550,500,450	100.0

Payroll represents wages and salaries paid to all employees of all companies. The relatively small construction payroll has been excluded as constituting capital expenditures subsequently recoverable through depreciation charges.

The amount available for dividends on common stock does not represent the total amount paid but only the portion provided by sales and revenues during the period covered.

Sales and other revenues represent the total amount available for the payment of all expenses and other obligations. In eliminating inter-company business, amounts applicable to transportation companies were partially estimated.

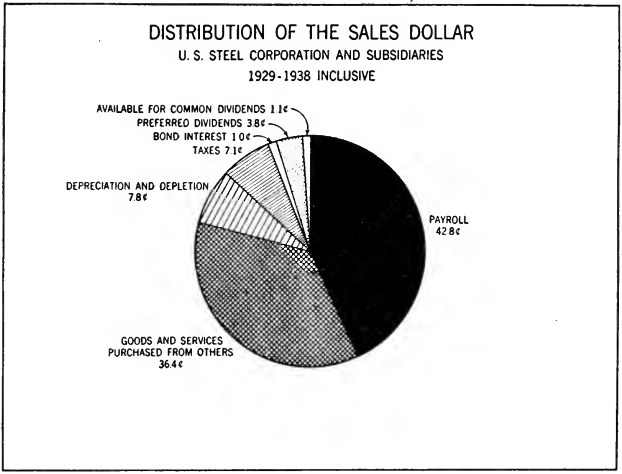
Distribution of sales dollar—year 1938—U. S. Steel Corporation and subsidiaries

Classification	Dollar Amount	Per Cent of Sales
Payroll (Wages and Salaries)	$275,364,898	45.0
Goods and Services Purchased from Others	237,454,811	38.9
Depreciation and Depletion	49,193,448	8.0
Taxes (Federal, State and Local)	48,842,131	8.0
Available to Apply on Bond Interest	544,874	0.1
Sales and Other Revenues	$611,400,162	100.0

Payroll represents wages and salaries paid to all employees of all companies. The relatively small construction payroll has been excluded as constituting capital expenditures subsequently recoverable through depreciation charges.

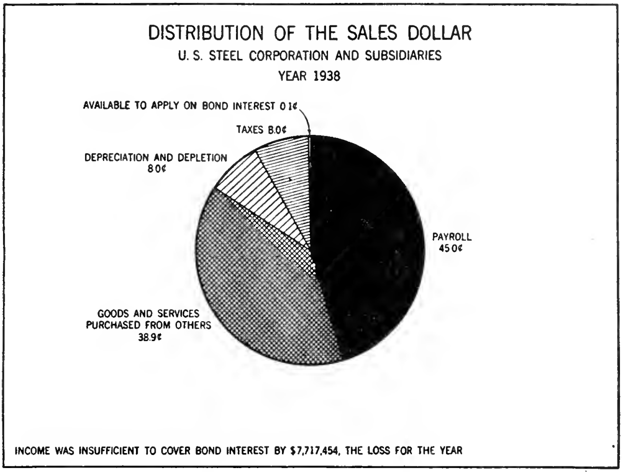
The amount available to apply on bond interest does not represent the total amount paid but only the portion provided by sales and revenues during the period covered.

Sales and other revenues represent the total amount available for the payment of all expenses and other obligations. In eliminating inter-company business, amounts applicable to transportation companies were partially estimated.



During the past ten years, 42.8¢ of every dollar of sales and other revenues of U. S. Steel Corporation and subsidiaries were paid to employees in wages and salaries. Despite a relatively high degree of integration, the Corporation spent 36.4¢ for goods and services purchased from others, e. g., scrap, non-ferrous metals, inward freight, electric power, tools, lubrication, etc. Depreciation of plant and equipment amounted to 7.8¢. Taxes absorbed 7.1¢.

There remained for the bondholders and stockholders only 5.9¢, of which 1.0¢ went for bond interest, 3.8¢ went for preferred dividends and 1.1¢ were available for dividends on the common stock.



In the year 1938, 45.0¢ out of every dollar of sales and other revenues of U. S. Steel Corporation and subsidiaries were paid to employees in wages and salaries, 38.9¢ were absorbed by goods and services purchased from others, 8.0¢ by depreciation of plant and equipment, and 8.0¢ by federal, state and local taxes.

The amount remaining was insufficient to cover bond interest by $7,717,454, the loss for the year. After payment of preferred dividends, the loss for the year was $32,937,131.

Payroll and earnings per dollar of sales—U. S. Steel Corporation and subsidiaries

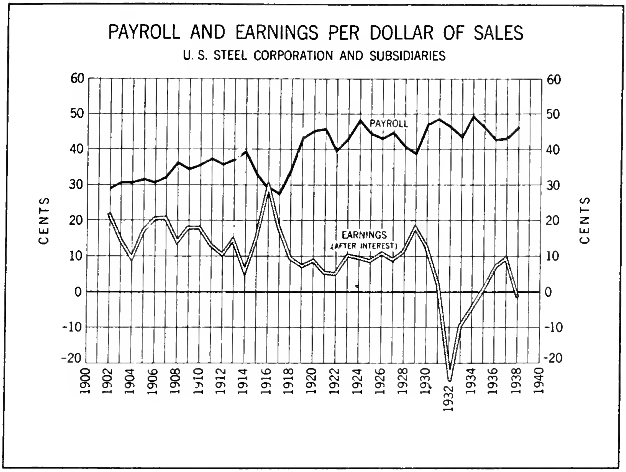
Year	Thousands of Dollars			Payroll per Dollar of Sales	Earnings per Dollar of Sales
	Payroll	Earnings (After Interest)	Sales and Other Revenues		
1902	120,528	90,307	422,187	$0.285	$0.214
1903	120,764	55,417	395,275	.306	.140
1904	99,778	30,268	324,682	.307	.093
1905	128,053	68,585	409,382	.313	.168
1906	147,766	98,129	484,535	.305	.203
1907	160,826	104,566	504,749	.319	.207
1908	120,511	45,729	331,807	.363	.138
1909	151,663	79,074	442,506	.343	.179
1910	174,955	87,407	492,574	.355	.177
1911	161,419	55,300	433,036	.373	.128
1912	189,352	54,240	535,490	.354	.101
1913	207,206	81,217	561,745	.369	.145
1914	162,380	23,497	413,166	.393	.057
1915	176,801	75,834	524,922	.337	.144
1916	263,386	271,532	903,033	.292	.300
1917	347,370	224,220	1,276,358	.272	.176
1918	452,664	125,317	1,328,248	.341	.094
1919	479,548	76,795	1,109,898	.432	.069
1920	581,557	109,694	1,295,849	.449	.085
1921	332,888	36,617	725,945	.458	.050
1922	322,678	39,653	809,310	.399	.049
1923	469,503	108,707	1,093,552	.429	.099
1924	442,459	85,067	920,742	.481	.092
1925	456,740	90,603	1,023,812	.446	.088
1926	467,409	116,667	1,087,165	.430	.107
1927	430,727	87,897	961,980	.448	.091
1928	413,700	114,174	1,010,952	.409	.113
1929	420,073	197,592	1,094,074	.384	.181
1930	391,271	104,422	840,226	.466	.124
1931	266,871	13,038	551,126	.484	.024
1932	133,913	[1] 71,176	288,664	.464	[1] .247
1933	163,150	[1] 36,501	377,179	.432	[1] .097
1934	210,504	[1] 21,668	423,201	.497	[1] .051
1935	251,577	1,147	544,173	.462	.002
1936	338,866	50,583	791,697	.428	.064
1937	442,928	94,944	1,028,761	.431	.092
1938	282,209	[1] 7,717	611,400	.462	[1] .013

[1] Indicates loss

Payroll represents total wages and salaries paid to all employees of all companies and includes a relatively small amount of construction payroll, which it was not possible to exclude in early years.

Earnings are after all charges, including interest, bond premium and discount, all taxes, and additions to bond sinking funds which were later applied to amortization of intangibles. Earnings after interest but before additions to bond sinking funds were about one cent more per dollar of sales than those shown, for the years 1901–1928, inclusive.

Sales and other revenues represent the total amount available for the payment of all expenses and other obligations. In eliminating inter-company business, amounts applicable to transportation companies were partially estimated.



Ever since the organization of U. S. Steel Corporation in 1901, the proportion of the sales dollar going to employees in the form of wages and salaries has had an upward trend, increasing from about 30¢ in 1901 to about 45¢ in 1938. The portion remaining as earnings available for dividends to stockholders, however, has declined, even more than the portion going to employees has increased.

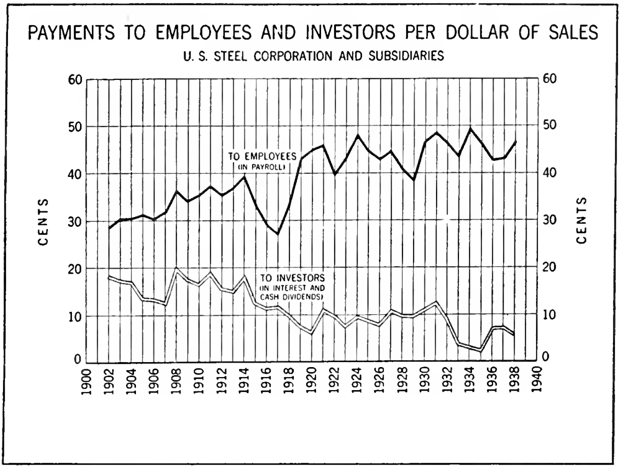
Payments to employees and to investors per dollar of sales—U. S. Steel Corporation and subsidiaries

Year	Thousands of Dollars			Payroll per Dollar of Sales	Interest and Dividends per Dollar of Sales
	Payroll	Interest and Cash Dividends	Sales and Other Revenues		
1902	120, 528	77, 354	422, 187	$0. 285	$0. 183
1903	120, 764	68, 748	395, 275	. 306	. 174
1904	99, 778	55, 311	324, 682	. 307	. 170
1905	128, 053	54, 986	409, 382	. 313	. 134
1906	147, 766	64, 787	484, 535	. 305	. 134
1907	160, 826	64, 738	504, 749	. 319	. 128
1908	120, 511	66, 650	331, 807	. 363	. 201
1909	151, 663	77, 056	442, 506	. 343	. 174
1910	174, 955	81, 265	492, 574	. 355	. 165
1911	161, 419	81, 779	433, 036	. 373	. 189
1912	189, 352	83, 204	535, 490	. 354	. 155
1913	207, 206	83, 936	561, 745	. 369	. 149
1914	162, 380	73, 700	413, 166	. 393	. 178
1915	176, 801	64, 327	524, 922	. 337	. 123
1916	263, 386	101, 739	903, 033	. 292	. 113
1917	347, 370	147, 704	1, 276, 358	. 272	. 116
1918	452, 664	127, 041	1, 328, 248	. 341	. 096
1919	479, 548	80, 779	1, 109, 898	. 432	. 073
1920	581, 557	79, 984	1, 295, 849	. 449	. 062
1921	332, 888	79, 127	725, 945	. 458	. 109
1922	322, 678	79, 002	809, 310	. 399	. 098
1923	469, 503	82, 459	1, 093, 552	. 429	. 075
1924	442, 459	88, 111	920, 742	. 481	. 096
1925	456, 740	87, 910	1, 023, 812	. 446	. 086
1926	467, 409	87, 559	1, 087, 165	. 430	. 080
1927	430, 727	101, 097	961, 980	. 448	. 106
1928	413, 700	100, 779	1, 010, 952	. 409	. 100
1929	420, 073	104, 014	1, 094, 074	. 384	. 095
1930	391, 271	91, 226	840, 226	. 466	. 109
1931	266, 871	67, 673	551, 126	. 484	. 123
1932	133, 913	26, 030	288, 664	. 464	. 090
1933	163, 150	12, 370	377, 179	. 432	. 033
1934	210, 504	12, 257	423, 201	. 497	. 029
1935	251, 577	12, 165	544, 173	. 462	. 022
1936	338, 866	55, 358	791, 697	. 428	. 070
1937	442, 928	72, 390	1, 028, 761	. 431	. 070
1938	282, 209	33, 482	611, 400	. 462	. 055

Payroll represents total wages and salaries paid to all employees of all companies and includes a relatively small amount of construction payroll, which it was not possible to exclude in early years.

Interest includes bond premium and discount.

Sales and other revenues represent the total amount available for the payment of all expenses and other obligations. In eliminating inter-company business, amounts applicable to transportation companies were partially estimated.



From 1902 to 1938, payroll payments to employees have absorbed an increasing proportion of the sales dollar of U. S. Steel Corporation and subsidiaries, while interest and cash dividend payments to investors have absorbed a decreasing proportion.

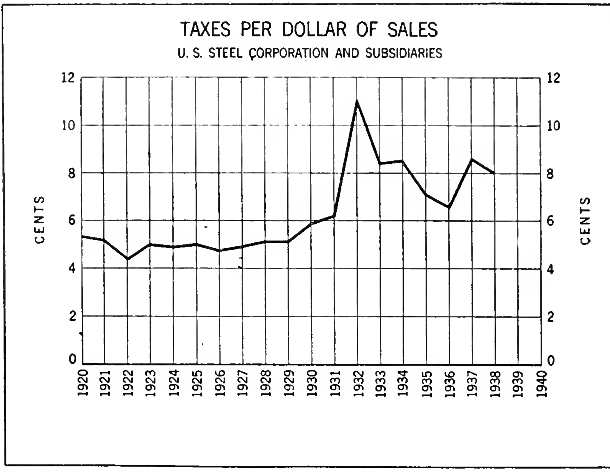
Taxes per dollar of sales—U. S. Steel Corporation and subsidiaries

Year	Total Taxes	Sales and Other Revenues	Taxes per Dollar of Sales	Year	Total Taxes	Sales and Other Revenues	Taxes per Dollar of Sales
1920	$68, 820, 598	$1, 295, 849, 375	$0. 053	1930	$49, 523, 594	$840, 226, 222	$0. 059
1921	37, 683, 727	725, 944, 864	0. 052	1931	34, 247, 632	551, 126, 423	0. 062
1922	35, 798, 450	809, 309, 543	0. 044	1932	31, 737, 202	288, 663, 837	0. 110
1923	55, 082, 523	1, 093, 551, 939	0. 050	1933	31, 709, 993	377, 179, 040	0. 084
1924	45, 276, 855	920, 742, 443	0. 049	1934	35, 780, 385	423, 201, 194	0. 085
1925	50, 923, 191	1, 023, 811, 883	0. 050	1935	38, 575, 010	544, 172, 546	0. 071
1926	52, 542, 237	1, 087, 164, 574	0. 048	1936	52, 150, 945	791, 696, 719	0. 066
1927	46, 755, 461	961, 979, 849	0. 049	1937	88, 048, 237	1, 028, 760, 629	0. 086
1928	51, 233, 103	1, 010, 952, 092	0. 051	1938	48, 842, 131	611, 400, 162	0. 080
1929	55, 386, 167	1, 094, 073, 678	0. 051				

Taxes include all federal, state and local taxes of all companies.

Federal tax adjustments made retroactive to years in which applicable; distribution of adjustments to years 1917–1920, inclusive, partly estimated.

Sales and other revenues represent the total amount available for the payment of all expenses and other obligations. In eliminating inter-company business, amounts applicable to transportation companies were partially estimated.



From 1920 through 1930, U. S. Steel Corporation and subsidiaries paid out each year in taxes approximately 5¢ out of every dollar of revenue from sales and other sources. In 1938 the tax collectors took about 8¢ out of every dollar of revenue.

The decrease in taxes per dollar of sales subsequent to 1932 was not the result of a decline in the total amount of taxes paid, which increased from $31,710,000 in 1933 to $88,048,000 in 1937 and $48,842,000 in 1938, but was due to such taxes being apportioned over an increased amount of sales.

Total taxes and earnings available for dividends—U. S. Steel Corporation and subsidiaries

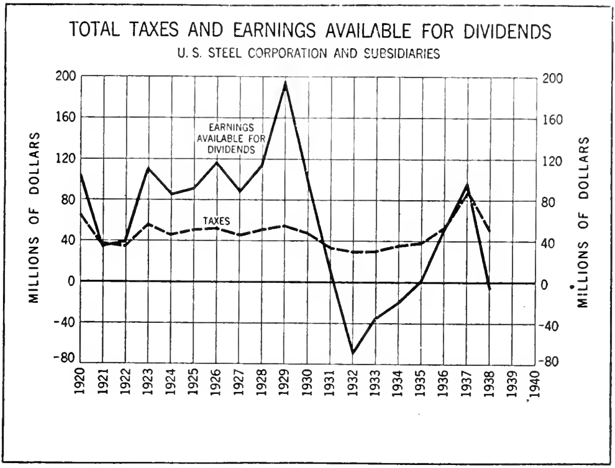
Year	Earnings Available for Dividends	Total Taxes	Year	Earnings Available for Dividends	Total Taxes
1920	$109, 694, 228	$68, 820, 598	1930	$104, 421, 571	$49, 523, 594
1921	36, 617, 017	37, 683, 727	1931	13, 038, 142	34, 247, 632
1922	39, 653, 455	35, 798, 450	1932	[1] 71, 175, 705	31, 737, 202
1923	108, 707, 065	55, 082, 523	1933	[1] 36, 501, 123	31, 709, 993
1924	85, 067, 192	45, 276, 855	1934	[1] 21, 667, 780	35, 780, 385
1925	90, 602, 653	50, 923, 191	1935	1, 146, 708	38, 575, 010
1926	116, 667, 405	52, 542, 237	1936	59, 583, 356	52, 150, 945
1927	87, 896, 836	46, 755, 461	1937	94, 944, 358	88, 048, 237
1928	114, 173, 775	51, 233, 103	1938	[1] 7, 717, 454	48, 842, 131
1929	197, 592, 060	55, 386, 167			

[1] Indicates loss.

Earnings are after all charges, including interest, bond premium and discount, all taxes, and additions to bond sinking funds which were later applied to amortization of intangibles.

Taxes include all federal, state and local taxes of all companies.

Federal tax adjustments made retroactive to years in which applicable; distribution of adjustments to years 1917-1920, inclusive, partly estimated.



From 1930 through 1938, U. S. Steel Corporation's total tax bill amounted to about $410,615,000, whereas during this period earnings available for dividends to stockholders were about $127 072,000. Thus, the Corporation during the last nine years has paid in taxes over three times as much as the earnings available for dividends to stockholders.

Assets, earnings and taxes—U. S. Steel Corporation and subsidiaries

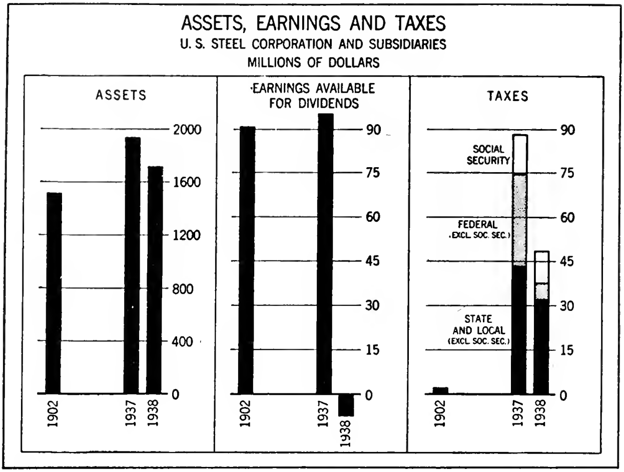
Item	1902	1937	1938
Total Assets	$1,511,798,510	$1,918,729,289	$1,711,279,006
Earnings Available for Dividends	90,306,525	94,944,358	[1] 7,717,454
Taxes:			
State and Local (Excl. Social Security)	2,391,466	42,882,565	32,044,825
Federal (Excl. Social Security)		31,749,768	5,488,091
Social Security		13,415,904	11,309,215
Total Taxes	2,391,466	88,048,237	48,842,131

[1] Indicates loss.

Assets are as shown on books at the end of each year, including intangibles.

Earnings are after all charges, including interest, bond premium and discount, all taxes, and additions to bond sinking funds which were later applied to amortization of intangibles.

Taxes include all federal, state and local taxes of all companies.



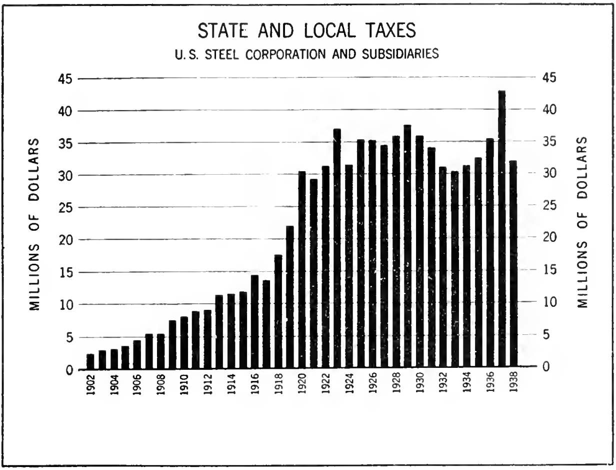
From 1902 to 1937-1938 (these two years being averaged), assets of U. S. Steel Corporation increased 20%, earnings available for dividends declined 51% and taxes rose 2750%.

In this comparison the year 1902 was selected because it was the first full year of the Corporation's operation; an average of the years 1937 and 1938 was used because operations were high in one year and low in the other year, the average being considered representative of present day conditions.

State and local taxes—U. S. Steel Corporation and subsidiaries

Year	Amount	Year	Amount
1902	$2,391,466	1921	$29,227,488
1903	2,972,600	1922	31,251,245
1904	3,052,967	1923	37,005,965
1905	3,646,490	1924	31,513,311
1906	4,356,126	1925	35,298,993
1907	5,383,924	1926	35,266,010
1908	5,361,160	1927	34,469,585
1909	7,597,871	1928	35,854,669
1910	8,078,585	1929	37,617,085
1911	8,846,422	1930	35,954,861
1912	9,117,678	1931	34,145,185
1913	11,296,095	1932	31,065,300
1914	11,433,763	1933	30,335,893
1915	11,804,650	1934	31,255,688
1916	14,390,155	1935	32,433,367
1917	13,577,204	1936	35,397,155
1918	17,501,453	1937	42,882,565
1919	21,968,387	1938	32,044,825
1920	30,581,138		

Data exclude social security taxes.



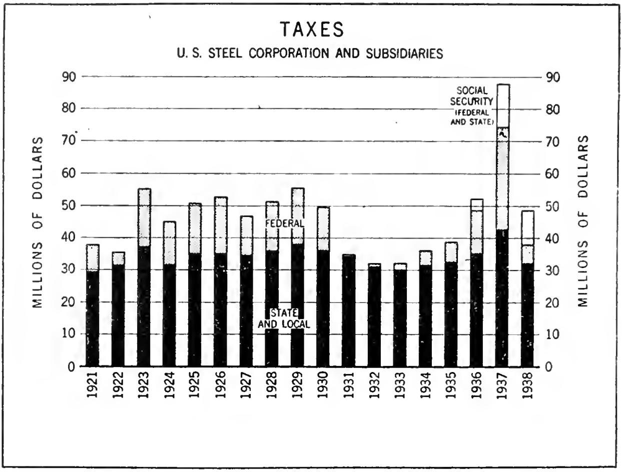
State and local taxes of U. S. Steel Corporation increased steadily from about $2,400,000 in 1902 to approximately $13,500,000 in 1917. Between 1917 and 1920, these taxes more than doubled, although the Corporation's ingot capacity increased less than 1.5% and its investment in property account only about 5% during this period. From 1921 through 1938, state and local taxes varied between $29,000,000 and $43,000,000, the variation being largely due to differences in volume of operations. However, even in 1932, the year of lowest operations, these taxes amounted to over $30,000,000.

The great increase in state and local taxes after 1917 was not the result of a corresponding increase in taxable property, but was largely caused by increased assessments and tax rates, state and local.

Taxes—U. S. Steel Corporation and subsidiaries

Year	State and Local (Excl. Social Security)	Federal (Excl. Social Security)	Social Security	Total
1921	$29, 227, 488	$8, 456, 239		$37, 683, 727
1922	31, 251, 245	4, 547, 205		35, 798, 450
1923	37, 005, 965	18, 076, 558		55, 082, 523
1924	31, 513, 311	13, 763, 544		45, 276, 855
1925	35, 298, 993	15, 624, 198		50, 923, 191
1926	35, 266, 010	17, 276, 227		52, 542, 237
1927	34, 469, 585	12, 285, 876		46, 755, 461
1928	35, 854, 669	16, 378, 434		51, 233, 103
1929	37, 617, 085	17, 769, 082		55, 386, 167
1930	35, 954, 861	13, 568, 733		49, 523, 594
1931	34, 145, 185	102, 447		34, 247, 632
1932	31, 065, 300	671, 902		31, 737, 202
1933	30, 335, 893	1, 374, 100		31, 709, 993
1934	31, 255, 688	4, 524, 697		35, 780, 385
1935	32, 433, 367	6, 141, 643		38, 575, 010
1936	35, 397, 155	13, 416, 670	$3, 337, 120	52, 150, 945
1937	42, 882, 565	31, 749, 768	13, 415, 904	88, 048, 237
1938	32, 044, 825	5, 488, 091	11, 309, 215	48, 842, 131

Taxes include all federal, state and local taxes of all companies.
Federal tax adjustments made retroactive to years in which applicable; distribution of adjustments to years 1917–1920, inclusive, partly estimated.



The heavy burden to U. S. Steel Corporation of state and local taxes is ever present, whether the Corporation is operating at a profit or a loss.

While federal taxes, excluding social security taxes, are less in years of low operations because of lower income taxes, the amount of federal taxes now paid in a prosperous year is much greater than formerly. Federal taxes in 1937 were about $31,750,000 as contrasted with about $17,769,000 in 1929, an increase of nearly 80%, despite the fact that production in 1937 did not reach the level of 1929.

Social security taxes now add an additional $10,000,000 to $15,000,000 annually to the Corporation's tax bill.

The Corporation paid nearly $50,000,000 in taxes in 1938, despite the fact that a deficit, after interest, of nearly $8,000,000 was incurred.

Taxes paid in 1937 and 1938—U. S. Steel Corporation and subsidiaries

Item	1937	1938	1937-38 Average
Total Taxes	$88,048,237	$48,842,131	$68,445,184
Total Employees	261,293	202,108	231,700
Tons of Iron and Steel Shipped	13,579,586	7,159,543	10,369,564
Sales and Other Revenues	$1,028,760,629	$611,400,162	$820,080,390
Shares of Common Stock	8,703,252	8,703,252	8,703,252
Taxes Per Employee	$336.97	$241.66	$295.40
Taxes Per Ton of Iron and Steel Shipped	$6.40	$6.70	$6.50
Taxes Per $100 of Sales	$8.56	$7.99	$8.35
Taxes Per Share of Common Stock	$10.12	$5.61	$7.86

Taxes include all federal, state and local taxes of all companies.

Iron and steel shipped includes rolled and finished steel products, pig iron, ferro-manganese and ing ts.

Sales and other revenues represent the total amount available for the payment of all expenses and other obligations. In eliminating inter-company business, amounts applicable to transportation companies were partially estimated.

In calculating amount of taxes per ton of steel shipped, taxes of cement manufacturing subsidiaries, amounting to $1,142,634 and $901,744 in 1937 and 1938, respectively, were eliminated; taxes of certain companies, the operations of which are not entirely lated to the production, sale and distribution of steel, were included in full because satisfactory alloca was not possible.

U. S. Steel Corporation and subsidiaries paid $136,890,368 in taxes during 1937 and 1938

This is equivalent to an average cost per year of:

$295.40 per employee,
$6.50 per ton of iron and steel shipped
$8.35 per $100 of sales,
$7.86 per share of common stock.

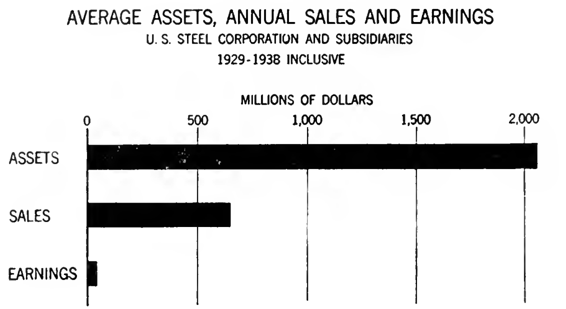
An average of the years 1937 and 1938 was used because operations were high in one year and low in the other year, the average being considered representative of present day conditions.

Average assets, annual sales and earnings—U. S. Steel Corporation and subsidiaries—1929–1938 inclusive

Year	Total Assets	Sales and Other Revenues	Earnings
1929	$2,286,183,655	$1,094,073,678	$212,536,930
1930	2,394,544,611	840,226,222	110,061,667
1931	2,279,802,813	551,126,423	18,507,766
1932	2,158,732,222	288,663,837	[1] 65,862,244
1933	2,102,896,880	377,179,040	[1] 31,336,670
1934	2,084,112,287	423,201,194	[1] 16,616,728
1935	1,822,401,742	544,172,546	6,106,488
1936	1,863,976,519	791,696,719	55,501,787
1937	1,918,729,289	1,028,760,629	100,085,445
1938	1,711,279,008	611,400,162	544,874
Average	2,062,265,902	655,050,045	38,952,931

[1] Indicates loss.

Total assets are as shown on books at the end of each year, including intangibles.
Sales and other revenues represent the total amount available for the payment of all expenses and other obligations. In eliminating inter-company business, amounts applicable to transportation companies were partially estimated.
Earnings are before interest but after all other charges, including all taxes.



A HUGE INVESTMENT IN RELATION TO SALES IS CHARACTERISTIC OF THE STEEL BUSINESS. EARNINGS WERE 5.9% OF SALES BUT ONLY 1.9% OF ASSETS.

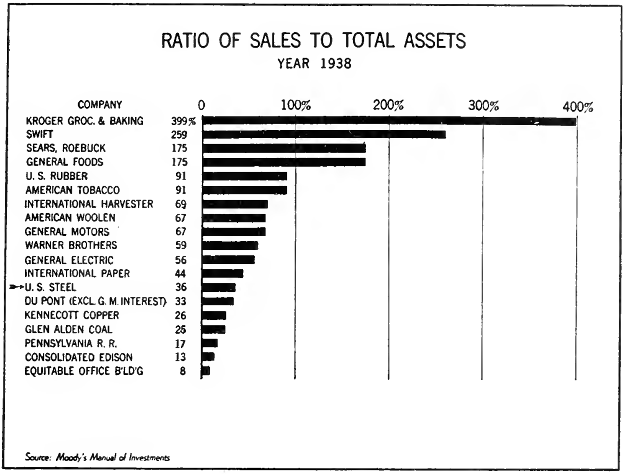
The integrated production of steel requires a heavy investment in iron ore and coal mines, transportation facilities, coke ovens, blast furnaces and steel mills. The ratio of sales to assets, therefore, is low.

Although earnings of U. S. Steel Corporation and subsidiaries during the period 1929-1938, inclusive, were 5.9% of sales and other revenues, they were only 1.9% of assets.

Ratio of sales to total assets—Year 1938

Company	Millions of Dollars		Ratio of Sales to Assets	Company	Millions of Dollars		Ratio of Sales to Assets
	Sales	Total Assets			Sales	Total Assets	
Kroger Groc. & Baking	231.3	57.9	399	General Electric	209.5	374.5	56
Swift	793.8	306.5	259	International Paper	97.5	220.7	44
Sears, Roebuck	501.7	286.1	175	U. S. Steel	611.4	1,711.3	36
General Foods	135.2	89.0	175	Du Pont (Excl. G. M. Interest)	235.4	720.0	33
U. S. Rubber	154.9	170.1	91	Kennecott Copper	89.1	342.9	26
American Tobacco	253.1	276.7	91	Glen Alden Coal	35.1	139.0	25
International Harvester	282.4	406.6	69	Pennsylvania R. R	385.0	2,322.4	17
American Woolen	42.0	62.5	67	Consolidated Edison	139.4	1,061.1	13
General Motors	1,067.0	1,598.0	67	Equitable Office Building	3.1	36.8	8
Warner Brothers	102.2	174.4	59				

Source: Moody's Manual of Investments (except for U. S. Steel data).
Sales include all revenues resulting from the sale of goods or services or from other activities in which the company is engaged. In most instances the figures are net, after deduction of the amount of returns and allowances. Slight differences in account classification exist but they are not sufficient materially to impair comparability.
Total assets are as of end of fiscal year, usually December 31st.



In the year 1938 sales of U. S. Steel Corporation and subsidiaries were equal to 36% of total assets.

Companies which perform only a small part of the entire process of production, fabrication, and distribution characteristically have a high ratio of sales to total assets. On the other hand, highly integrated companies, such as U. S. Steel Corporation, which perform a large part of the entire process from the production of raw materials to the fabrication and distribution of the finished product, as well as companies such as railroad and utility companies requiring a heavy investment for the services rendered, have a low ratio of sales to total assets.

When turnover is high, profit margins can be low. When turnover is low, profit margins must be higher in order to produce an adequate return on investment.

Average monthly prices of common and preferred stocks—U. S. Steel Corporation

	Common	Preferred		Common	Preferred
	1929			1930	
Jan	$174.94	$142.51	Jan	$175.31	$141.88
Feb	180.25	142.50	Feb	183.06	141.94
Mar	182.69	142.63	Mar	186.00	144.25
Apr	184.06	142.76	Apr	189.50	145.19
May	174.50	142.50	May	174.75	145.13
June	178.44	140.50	June	162.69	145.50
July	200.13	140.13	July	161.63	145.69
Aug	234.63	141.44	Aug	163.88	145.94
Sep	241.44	143.13	Sep	164.25	148.69
Oct	200.25	141.19	Oct	151.81	148.88
Nov	170.38	140.38	Nov	143.88	146.38
Dec	172.81	141.07	Dec	140.94	143.13

Average monthly prices of common and preferred stocks—U. S. Steel Corporation—Continued

	Common	Preferred
1931		
Jan	$141.44	$145.63
Feb	145.13	146.32
Mar	144.63	148.25
Apr	127.63	148.01
May	105.44	142.00
Jun	93.94	139.50
Jul	94.63	140.63
Aug	88.50	138.25
Sep	79.75	130.13
Oct	67.75	119.25
Nov	63.94	116.75
Dec	45.63	104.63
1932		
Jan	$41.19	$104.69
Feb	45.00	106.25
Mar	45.00	97.00
Apr	34.13	84.38
May	28.44	72.13
Jun	25.81	63.00
Jul	25.38	62.19
Aug	38.50	77.94
Sep	44.06	79.94
Oct	38.56	73.57
Nov	35.44	71.94
Dec	29.50	61.07
1933		
Jan	$29.31	$62.94
Feb	26.38	57.94
Mar	28.56	60.25
Apr	30.00	69.13
May	49.50	88.25
Jun	55.50	94.50
Jul	58.25	99.25
Aug	53.88	96.13
Sep	50.31	85.82
Oct	41.63	79.25
Nov	40.69	79.07
Dec	46.50	87.38
1934		
Jan	$52.19	$93.75
Feb	57.06	93.50
Mar	52.75	91.50
Apr	49.94	93.69
May	43.31	88.75
Jun	40.31	84.07
Jul	37.44	83.19
Aug	34.06	80.07
Sep	32.13	73.13
Oct	33.13	74.50
Nov	35.31	78.94
Dec	37.81	83.13
1935		
Jan	$37.88	$89.00
Feb	35.06	84.13
Mar	30.25	77.32
Apr	31.00	82.38
May	33.06	87.75
Jun	32.50	86.50
Jul	$38.56	$94.13
Aug	43.69	105.75
Sep	45.63	109.75
Oct	44.63	108.19
Nov	48.25	112.88
Dec	46.56	113.25
1936		
Jan	$48.38	$118.25
Feb	57.31	124.50
Mar	64.06	129.75
Apr	63.69	127.00
May	57.88	122.63
Jun	61.63	126.82
Jul	62.50	126.63
Aug	67.88	135.50
Sep	71.25	138.13
Oct	74.69	145.00
Nov	75.69	150.32
Dec	76.75	143.32
1937		
Jan	$86.13	$144.88
Feb	104.94	147.25
Mar	118.56	146.50
Apr	109.06	140.63
May	100.19	134.25
Jun	99.75	131.63
Jul	107.13	133.50
Aug	114.44	131.69
Sep	94.31	124.50
Oct	65.94	111.63
Nov	55.31	108.00
Dec	56.31	108.32
1938		
Jan	$56.69	$109.57
Feb	53.44	106.94
Mar	47.00	101.63
Apr	43.50	100.25
May	43.38	96.00
Jun	50.06	100.57
Jul	57.88	107.94
Aug	59.50	110.94
Sep	56.06	111.00
Oct	62.63	118.75
Nov	66.13	116.94
Dec	65.18	116.13
1939		
Jan	$60.44	$116.13
Feb	61.18	116.25
Mar	57.68	118.88
Apr	48.81	110.88
May	47.06	104.56
Jun	47.00	106.88
Jul	49.88	108.63
Aug	48.44	107.50
Sep	71.94	115.44
Oct	----	-------
Nov	----	-------
Dec	--	-------

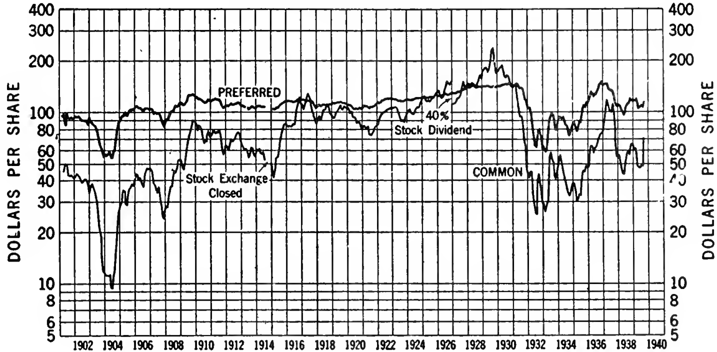
Source: Data based on quotations on New York Stock Exchange fr ommercial and Financial Chronicle and The Annalist.

Figures are averages of monthly high and low quotations.

AVERAGE PRICES OF COMMON AND PREFERRED STOCKS

AVERAGES OF MONTHLY HIGH AND LOW PRICES ON NEW YORK STOCK EXCHANGE

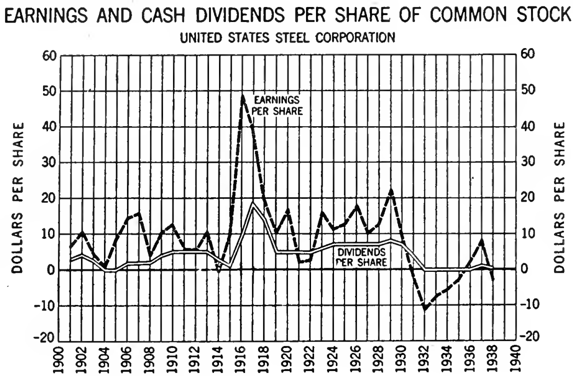
UNITED STATES STEEL CORPORATION



Source: Commercial and Financial Chronicle and The Annalist

The relatively low price of the U. S. Steel Corporation common stock within recent years is a reflection of the competitive position and small profit margin of the steel industry. The book value of common stock on December 31, 1938 was $113.10 per share.

The behavior of the monthly average price of the preferred stock of the Corporation, which previous to the 1932 depression had not been below par since the panic of 1907, is also a reflection of conditions in the steel industry during recent years.



From 1901 through 1930, consolidated earnings of U. S. Steel Corporation and subsidiaries available for dividends on the common stock of the Corporation averaged roughly $10 per share. About one half of this was paid out in dividends and most of the remainder retained in the business was investc in plant and equipment.

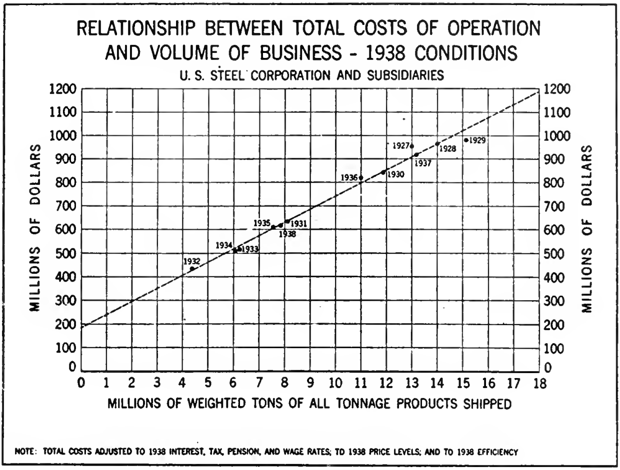
From 1931 through 1938, earnings per share were exceeded by losses. The common stock has received no dividend since 1931, with the exception of $1.00 per share paid in 1937.

Section B—Costs

Relationship between total costs of operation and volume of business—1938 conditions—United States Steel Corporation and subsidiaries

Year	Millions of Weighted Tons of Products Shipped	Costs—1938 Conditions (Millions of Dollars)	Year	Millions of Weighted Tons of Products Shipped	Costs—1938 Conditions (Millions of Dollars)
1927	13.0	954.5	1933	6.2	512.0
1928	14.0	966.2	1934	6.1	510.0
1929	15.1	979.0	1935	7.6	610.3
1930	11.9	838.8	1936	11.0	818.2
1931	8.1	628.9	1937	13.2	916.2
1932	4.4	436.0	1938	7.8	614.3

Average relationship: Costs=$182,100,000 plus $55.73 per weighted ton of products shipped.
Total costs are adjusted to 1938 interest, pension, wage, and tax rates, to 1938 price level, and to 1938 efficiency.
Weighted tonnages are actual tonnages, adjusted for change in proportions of high and low cost products and for the equivalent tonnage of average cost rolled and finished steel products represented by products other than steel.



The average relationship between volume and cost in the operations of U. S. Steel Corporation and subsidiaries, as indicated by the costs for each of the years 1927 to 1938 adjusted to 1938 conditions, is such that the total costs as of 1938 for any volume of business may be estimated by multiplying the weighted tons of products shipped by $55.73 and adding $182,100,000. These costs are exclusive of all non-operating income and expense and of all intercompany transactions, but they cover all operations of the Corporation's subsidiaries and, hence, do not represent merely the cost of producing steel.

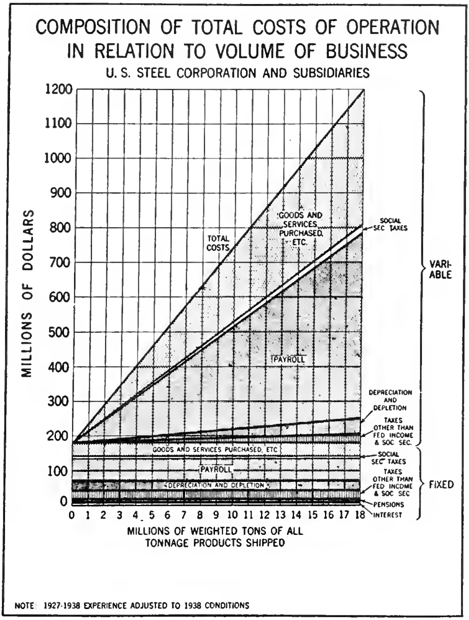
In using weighted tonnages as the measure of volume, the weighted tonnage figure for each year represents the number of gross tons of average cost rolled and finished steel which would be the cost equivalent of the actual tons of various types of steel and other products sold during the year.

The costs embraced in the $182,100,000 are those which are incurred regardless of differences in volume ranging from 17.7% to 90.4% of annual ingot capacity and, hence, may be termed "fixed costs". The $55.73 per ton represents the additional costs incurred with the expansion in operations represented by each weighted ton of product shipped. Since the average cost amounts to $55.73 per ton plus the pro rata portion of fixed costs and since the $182,100,000 of fixed costs can be distributed over more units as production is increased, the average cost per ton will obviously decrease as volume rises, but the decrease is not as great as is sometimes popularly supposed.

Composition of total costs of operation in relation to volume of business—United States Steel Corporation and subsidiaries

Item	Costs That Must Be Met Regardless of Operating Rate	Additional Costs for Each Additional Weighted Ton of Product Shipped
Interest	$8,300,000	$0.00
Pensions	7,700,000	0.00
Depreciation and Depletion	29,500,000	2.37
Taxes other than Social Security and Federal Income	24,200,000	1.43
Payrolls	62,100,000	29.10
Social Security Taxes	2,500,000	1.16
Goods and Services Purchased, etc	47,800,000	21.67
Total Costs	$182,100,000	$55.73

Data are based on cost-volume relationship indicated by 1927 to 1938 costs, adjusted to 1938 conditions.
Weighted tonnages are actual tonnages, adjusted for change in proportions of high and low cost products, and for the equivalent tonnage of average cost rolled and finished steel products represented by products other than steel.



The total costs of operation of U. S. Steel Corporation and subsidiaries embrace some items of cost which, at 1938 interest, wage and tax rates and 1938 price levels, would remain constant throughout the entire range of volume within which the Corporation has operated during the period 1927 to 1938, while other items of cost vary directly with the volume of business as indicated by the volume of shipments.

Of the $182,100,000 of fixed costs, over one-third represents payroll while less than one-sixth consists of depreciation and depletion. Of the items which vary with increases in volume, payrolls and goods and services purchased represent by far the most important items, representing over 90% of the additional costs per ton.

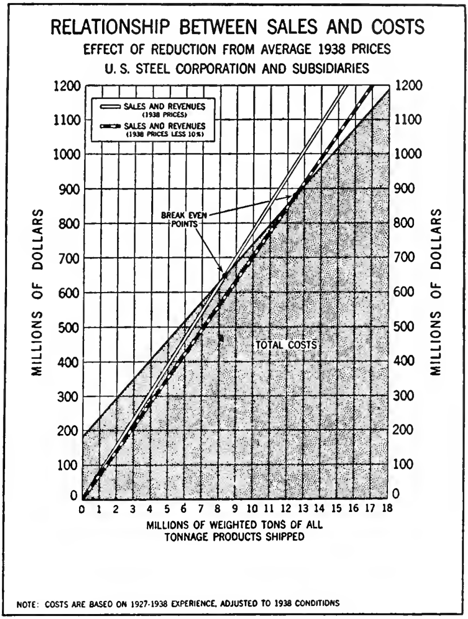
The above costs cover all operations of U. S. Steel Corporation and subsidiaries and do not reflect merely the cost of producing steel. The weighted tons shipped, which are the equivalent gross tons of average cost rolled and finished steel products represented by the actual tons of products shipped, are used as an indicator of the volume of all operations. 18,000,000 weighted tons represent capacity operations.

Relationship between sales and costs—effect of reduction from average 1938 prices—United States Steel Corporation and subsidiaries

Item	Fixed	Variable (Per Weighted Ton Shipped)
Total Costs	$182, 100, 000	$55. 73
Sales, Average 1938 Prices		$71. 86
Revenues from Transportation and Miscellaneous Operations		5. 80
Total Sales and Revenues, Average 1938 Prices		77. 66
Sales, Average 1938 Prices Less 10%		$64. 67
Revenues from Transportation and Miscellaneous Operations		5. 80
Total Sales and Revenues, Average 1938 Prices Less 10%		70. 47

Cost-volume relationship is that indicated by 1927-1938 costs, adjusted to 1938 conditions. Variation in costs with changes in volume suppose no changes in wage, interest or tax rates, in pension payments, or in material prices.

Weighted tonnages are actual tonnages, adjusted for changes in the proportions of high and low cost products, and for the equivalent tonnage of average cost rolled and finished steel products represented by products other than steel.

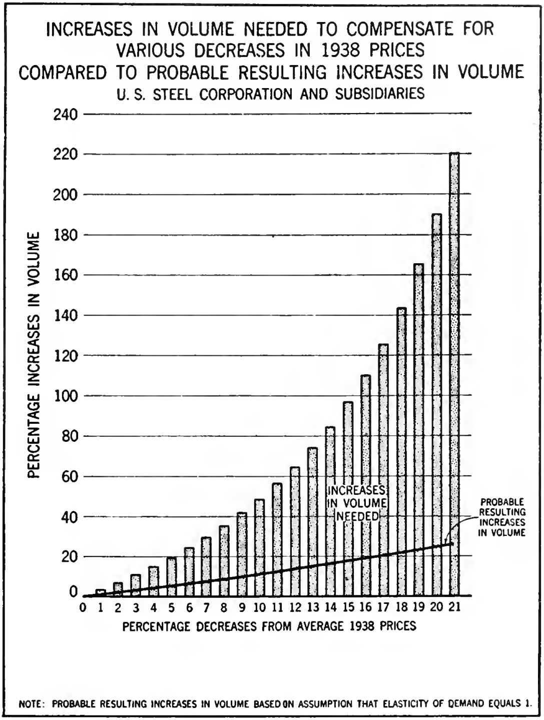


While an increase in the volume of steel sold results in a considerable reduction in costs per ton, the reduction is not so great as to permit of any sizeable reduction in price without a much greater relative increase in volume. At the average amount of sales and revenues per weighted ton prevailing in 1938, total sales and revenues would be sufficient to cover total costs if shipments amounted to about 8,300,000 weighted tons or more, which is equivalent to an operating rate of 40% to 45% of capacity, depending upon the type of products shipped. A reduction of 10% from the average 1938 prices would so reduce the total sales and revenues that the break-even point would not be reached until shipments had reached about 12,400,000 weighted tons, as indicated by the intersection of the dashed line with the total cost line. Hence, a 10% reduction in price could be offset only by a 48.8% increase in volume. This relationship is not confined to the break-even point, for to net any particular amount of profit or loss at prices 10% below the average 1938 level would require a volume 48.8% above that required at average 1938 prices.

Increases in volume needed to compensate for various decreases in 1938 prices compared to probable resulting increases in volume—U. S. Steel Corporation and subsidiaries

Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1	Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1
1	3.4	1.0	12	64.8	13.6
2	7.0	2.0	13	74.2	14.9
3	10.9	3.1	14	84.8	16.3
4	15.1	4.2	15	96.7	17.7
5	19.6	5.3	16	110.3	19.1
6	24.5	6.4	17	125.8	20.5
7	29.8	7.5	18	143.9	22.0
8	35.5	8.7	19	165.0	23.5
9	41.8	9.9	20	190.3	25.0
10	48.8	11.1	21	220.8	26.6
11	56.4	12.4			

Estimates of increase in volume needed based on cost-volume relationship indicated by 1927–1938 costs adjusted to 1938 conditions, and suppose no change in wage, interest, or tax rates, in pension payments, or in material prices.



The increases in the volume of steel sold which would have been likely to have resulted from decreases in the average 1938 prices would have been but a small fraction of the percentage increases necessary to compensate for the respective reductions.

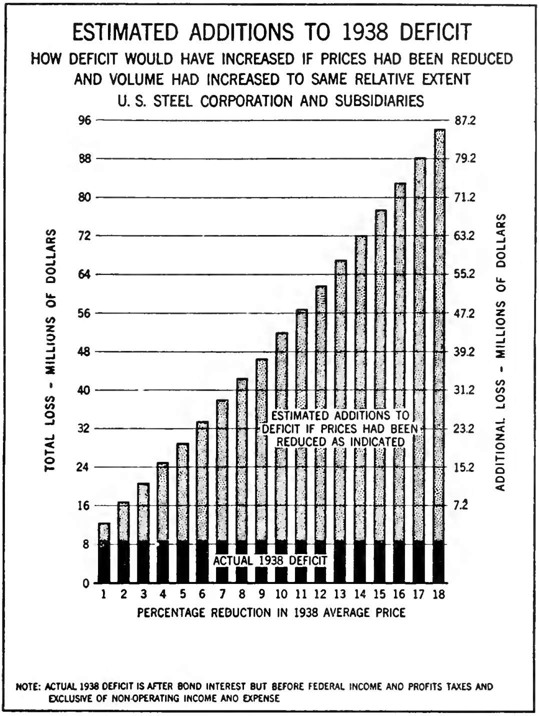
The elasticity of demand for a product is measured by the ratio of the relative resulting increase in the volume to the relative decrease in price. Both actual business experience and statistical analyses indicate that the elasticity of demand for steel is less than 1. Thus cutting prices in half could no more than double volume. It is on the basis of an elasticity of 1 that the probable increase in volume has been computed.

The estimate of the increase in volume needed takes into consideration the effect of the increased volume in reducing costs per ton.

Estimated additions to 1938 deficit—How deficit would have increased if prices had been reduced and volume had increased to same relative extent—U. S. Steel Corporation and subsidiaries

Percentage Reduction in Price	Estimated Additional Loss, Assuming Elasticity of Demand for Steel of 1	Percentage Reduction in Price	Estimated Additional Loss, Assuming Elasticity of Demand for Steel of 1
1	$3,900,000	11	$48,100,000
2	7,900,000	12	53,100,000
3	12,000,000	13	58,200,000
4	16,200,000	14	63,400,000
5	20,500,000	15	68,700,000
6	24,900,000	16	74,200,000
7	29,300,000	17	79,800,000
8	33,900,000	18	85,500,000
9	38,500,000	19	91,400,000
10	43,300,000	20	97,400,000

Estimated additional loss based on cost-volume relationship indicated by 1927-1938 costs adjusted to 1938 conditions, and supposes no change in wage, interest, or tax rates, in pension payments, or in material prices.



The elasticity of demand for a product is measured by the ratio of the resulting relative increase in volume to the relative decrease in price.

Analyses of the demand for steel indicate that steel has an elasticity of demand no greater than 1. Thus, cutting steel prices in half could no more than double the volume.

If an attempt had been made to stimulate the volume of steel sold during the recession of 1938 by decreasing prices further than was actually required by competition, the increase in volume which would have resulted would not have been sufficient to compensate for the price reduction. On the contrary, any further decrease in prices would have served but to increase the 1938 deficit, and the greater the reduction, the more the deficit would have increased.

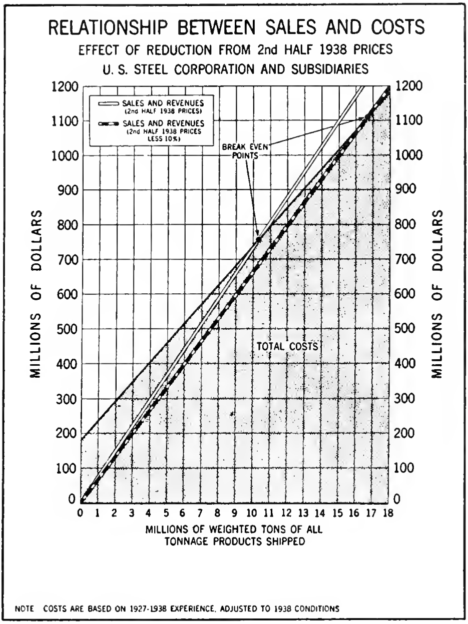
Relationship between sales and costs—Effect of reduction from 2nd half of 1938 prices—U. S. Steel Corporation and subsidiaries

Item	Fixed	Variable (Per Weighted Ton Shipped)
Total Costs	$182,100,000	$55.73
Sales, Average 2nd Half 1938 Prices		$67.33
Revenues from Transportation and Miscellaneous Operations		5.80
Total Sales and Revenues, Average 2nd Half 1938 Prices		73.13
Sales, Average 2nd Half 1938 Prices Less 10%		$60.60
Revenues from Transportation and Miscellaneous Operations		5.80
Total Sales and Revenues, Average 2nd Half 1938 Prices Less 10%		66.40

Cost-volume relationship is that indicated by 1927–1938 costs, adjusted to 1938 conditions. Variation in costs with changes in volume suppose no changes in wage, interest or tax rates, in pension payments, or in material prices.

Sales per weighted ton prevailing in 2nd half of 1938 represent the average sales per weighted ton for 1938 reduced proportionately to the extent to which the selling value per weighted ton or rolled and finished steel products shipped during the 2nd half of 1938 was less than the average selling value of rolled and finished steel products for the entire year.

Weighted tonnages are actual tonnages, adjusted for changes in the proportions of high and low cost products, and for the equivalent tonnage of average cost rolled and finished steel products represented by products other than steel.

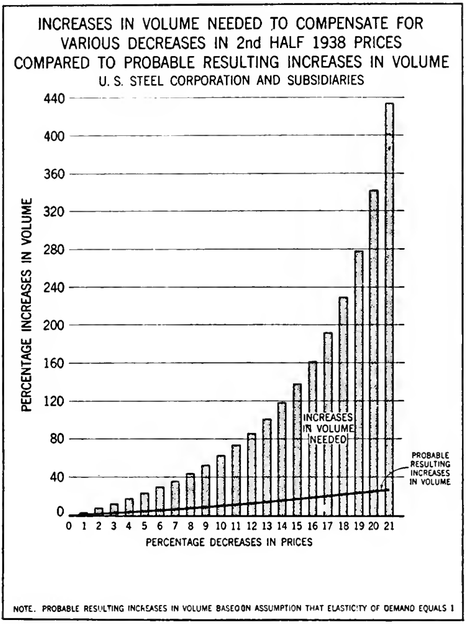


The reduction in the cost per ton of steel resulting from an increased volume of production is not so great as to permit of any sizeable reduction in price without a much greater relative increase in volume. At the average amount of sales and revenues per weighted ton prevailing during the second half of 1938, after the June 24, 1938 price reduction, total sales and revenues would be sufficient to cover total costs if annual shipments amounted to about 10½ million weighted tons or more, which is equivalent to an operating rate of about 50% to 55% of capacity, depending upon the type of product shipped. A reduction of 10% from this price level would so reduce the total sales and revenues that the break-even point would not be reached until over 17 million weighted tons were shipped, as indicated by the intersection of the dashed line with the total cost line. This would mean that the Corporation and its subsidiaries would not break even until operations had reached 90% of capacity, in which case operations would have to be carried on at the impossible rate of 130% of capacity to earn a return as modest as 5% on the investment in tangible assets.

Increases in volume needed to compensate for various decreases in 2nd half 1938 prices compared to probable resulting increases in volume—U. S. Steel Corporation and subsidiaries

Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1	Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1
1	4.0	1.0	12	86.7	13.6
2	8.4	2.0	13	101.3	14.9
3	13.1	3.1	14	118.3	16.3
4	18 3	4.2	15	138.4	17.7
5	24.0	5.3	16	162.7	19.1
6	30.2	6.4	17	192.4	20.5
7	37.2	7.5	18	229.7	22.0
8	44.8	8.7	19	277.9	23.5
9	53.5	9.9	20	342.6	25.0
10	63.1	11.1	21	434.1	26.6
11	74.1	12.4			

Estimates of increase in volume needed based on cost-volume relationship indicated by 1927-1938 costs adjusted to 1938 conditions, and suppose no change in wage, interest, or tax rates, in pension payments, or in material prices.



The probable increase in the volume of sales which would result from a decrease in steel prices from the level prevailing subsequent to the June 24, 1938 price reduction, is but a small fraction of the percentage increase which would be necessary to compensate for the price decrease. The divergence between the increase in volume needed and the increase in volume which would probably result from the price reduction is even greater than the divergence with respect to reductions from the average 1938 prices.

The elasticity of demand for a product is measured by the ratio of the relative resulting increase in the volume to the relative decrease in price. Both actual business experience and statistical analyses indicate that the elasticity of demand for steel is less than 1. Thus cutting prices in half could no more than double volume. It is on the basis of an elasticity of 1 that the probable increase in volume has been computed. The estimate of the increase in volume needed takes into consideration the effect of the increased volume in reducing costs per ton.

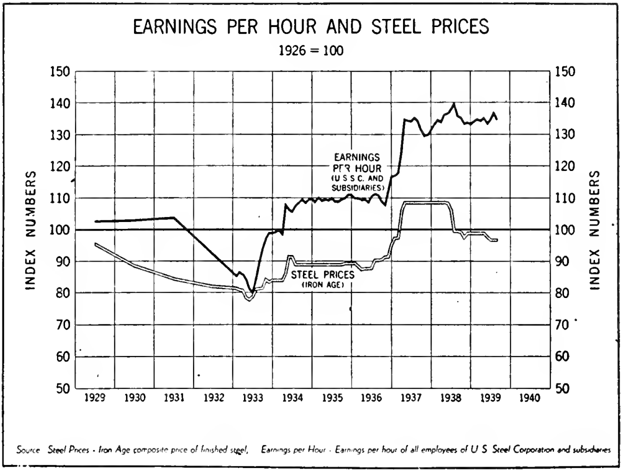
Earnings per hour and steel prices

[Earnings per hour=earnings per hour of all employees of United States Steel Corporation and subsidiaries; steel prices=Iron Age composite price of finished steel]

	Hourly earnings		Steel prices	
	Cents per hour	1926=100	Cents per pound	1926=100
1929	68.6	102.8	2.209	95.4
1830	68.7	103.0	2.048	88.5
1931	69.1	103.6	1.957	84.5
1932	61.4	92.1	1.901	82.1
1933				
Jan	56.9	85.3	1.885	81.4
Feb	57.7	86.5	1.873	80.9
Mar	57.3	85.9	1.867	80.6
Apr	56.1	84.1	1.817	78.5
May	54.3	81.4	1.802	77.8
Jun	53.3	79.9	1.820	78.6
Jul	56.3	84.4	1.878	81.1
Aug	59.6	89.4	1.883	81.3
Sep	62.7	94.0	1.890	81.6
Oct	64.6	96.9	1.950	84.2
Nov	65.9	98.8	1.933	83.5
Dec	65.8	98.7	1.945	84.0
1934				
Jan	66.0	99.0	1.945	84.0
Feb	66.5	99.7	1.945	84.0
Mar	65.5	98.2	1.945	84.0
Apr	72.0	107.9	1.988	85.9
May	71.0	106.4	2.118	91.5
Jun	70.6	105.8	2.11[illegible]	91.5
Jul	71.7	107.5	2.056	88.8
Aug	72.3	108.4	2.056	88.8
Sep	73.0	109.4	2.056	88.8
Oct	72.3	108.4	2.056	88.8
Nov	73.0	109.4	2.056	88.8
Dec	73.1	109.6	2.056	88.8
1935				
Jan	72.5	108.7	2.056	88.8
Feb	73.4	110.0	2.056	88.8
Mar	72.7	109.0	2.056	88.8
Apr	73.0	109.4	2.056	88.8
May	72.7	109.0	2.056	88.8
Jun	73.3	109.9	2.05	88.8
Jul	72.5	108.7	2.05	88.8
Aug	72.5	108.7	2.05	88.8
Sep	73.0	109.4	2.05	88.8
Oct	73.3	109.9	2.062	89.1
Nov	74.2	111.2	2.062	89.1
Dec	73.9	110.8	2.062	89.1
1936				
Jan	73.3	109.9	2.062	89.1
Feb	73.3	109.9	2.040	88.1
Mar	72.8	109.1	2.021	87.3
Apr	73.0	109.4	2.028	87.6
May	72.4	108.5	2.028	87.6
Jun	73.7	110.5	2.033	87.8
Jul	74.2	111.2	2.091	90.3
Aug	73.9	110.8	2.091	90.3
Sep	72.5	108.7	2.096	90.5
Oct	71.9	107.8	2.116	91.4
Nov	75.0	112.4	2.116	91.4
Dec	77.8	116.6	2.199	95.0
1937				
Jan	78.0	116.9	2.249	97.1
Feb	78.5	117.7	2.249	97.1
Mar	83.1	124.6	2.459	106.2
Apr	89.8	134.6	2.512	108.5
May	89.5	134.2	2.512	108.5
Jun	89.4	134.0	2.512	108.5
Jul	90.1	135.1	2.512	108.5
Aug	89.4	134.0	2.512	108.5
Sep	87.7	131.5	2.512	108.5
Oct	86.3	129.4	2.512	108.5
Nov	86.6	129.8	2.512	108.5
Dec	87.7	131.5	2.512	108.5
1938				
Jan	88.7	133.0	2.512	108.5
Feb	89.6	134.3	2.512	108.5
Mar	89.2	133.7	2.512	108.5
Apr	90.8	136.1	2.512	108.5
May	91.0	136.4	2.506	108.3
Jun	91.9	137.8	2.459	106.2
Jul	93.1	139.6	2.300	99.4
Aug	90.6	135.8	2.300	99.4
Sep	90.1	135.1	2.293	99.0
Oct	89.0	133.4	2.255	97.4
Nov	89.2	133.7	2.286	98.7
Dec	88.9	133.3	2.286	98.7
1939				
Jan	89.4	134.0	2.286	98.7
Feb	89.9	134.8	2.286	98.7
Mar	89.5	134.2	2.286	98.7
Apr	90.2	135.2	2.286	98.7
May	89.0	133.4	2.256	97.5
Jun	89.9	134.8	2.236	96.6
Jul	91.2	136.7	2.236	96.6
Aug	89.6	134.3	2.236	96.6

Steel prices are monthly averages of weekly figures.

The 1926 base for earnings per hour of all employees of U. S. Steel Corporation and subsidiaries was estimated from data on the total steel industry compiled by National Industrial Conference Board, as Corporation data are not available prior to 1929.



Payroll is such an important element of costs in steel production that increases in earnings per hour usually cause higher steel prices. However, earnings per hour are now about 35% above the level of 1926, whereas steel prices are slightly lower than they were in that year. Since wages and salaries average about 45% of the costs of U. S. Steel Corporation and subsidiaries, a 35% increase in hourly earnings causes approximately a 15% increase in total costs.

Unadjusted costs and volume of business compared with estimated costs for corresponding volumes under 1938 conditions—U. S. Steel Corporation and subsidiaries

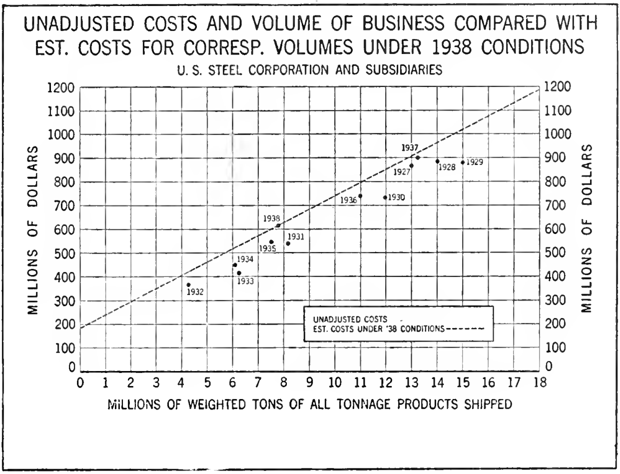
Year	Millions of Weighted Tons of Products Shipped	Unadjusted Costs (Millions of Dollars)	Year	Millions of Weighted Tons of Products Shipped	Unadjusted Costs (Millions of Dollars)
1926	14.9	956.7	1933	6.2	414.4
1927	13.0	867.0	1934	6.1	442.9
1928	14.0	884.5	1935	7.6	539.2
1929	15.1	880.1	1936	11.0	731.8
1930	11.9	724.9	1937	13.2	900.5
1931	8.1	539.4	1938	7.8	614.5
1932	4.4	361.2			

Estimated relationship of cost to volume under 1938 conditions: Costs=$182,100,000 plus $55.73 per weighted ton of products shipped.

Unadjusted costs are as per profit and loss statements submitted to Federal Trade Commission, February 7, 1939, exclusive of Federal income taxes, miscellaneous non-operating income and expense, and of inter-company items.

Estimated relationship of cost to volume is that indicated by 1927–1938 costs adjusted to 1938 interest, tax, pension and wage rates; to 1938 price levels; and to 1938 efficiency.

Weighted tonnages are actual tonnages, adjusted for change in proportions of high and low cost products and for the equivalent tonnage of average cost rolled and finished steel products represented by products other than steel.



Total costs of United States Steel Corporation and subsidiaries, exclusive of Federal income taxes, the net amount of miscellaneous non-operating income and expense, and of inter-company items, have been greater for a given volume of shipments in recent years than formerly. The year 1938, for instance, may be compared with 1935 and 1931, while 1937 may be contrasted with 1927 and 1928.

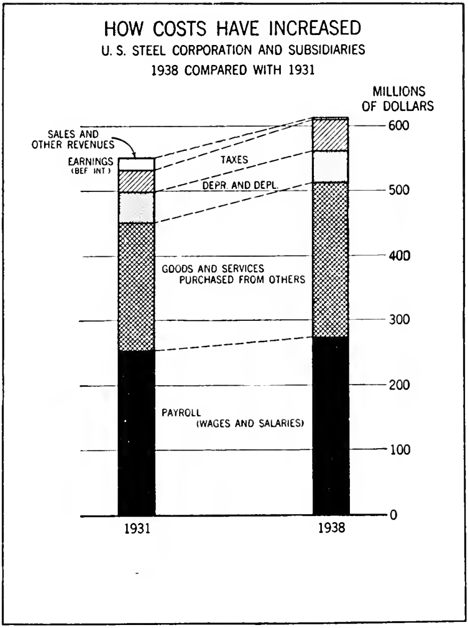
The dotted line represents the estimated total costs of the various volumes if 1938 interest, tax, and wage rates, pension payments, material prices and technological conditions had prevailed throughout the period. The combined effect of the various factors increasing and decreasing costs, such as increased wages, taxes, and material prices, and improved technology and efficiency has been to raise the cost level above the levels of each of the preceding years.

How costs have increased—U. S. Steel Corporation and subsidiaries—1938 compared with 1931

Item	1931	1938	Per Cent Increase '38 over '31
Payroll (Wages and Salaries)	$253,178,649	$275,364,898	9
Goods and Services Purchased from Others	197,874,481	237,454,811	20
Depreciation and Depletion	47,317,895	49,193,448	4
Taxes (Federal, State and Local)	34,247,632	48,842,131	43
Sales and Other Revenues	$551,126,423	$611,400,162	11
Earnings (Before Interest)	18,507,766	544,874	−97
Rolled and Finished Steel Products Shipped (Tons)	7,676,744	6,659,253	−13

Payroll represents wages and salaries paid to all employees of all companies. The relatively small construction payroll has been excluded as constituting capital expenditures subsequently recoverable through depreciation charges.

Sales and other revenues represent the total amount available for the payment of all expenses and other obligations. In eliminating inter-company business, amounts applicable to transportation companies were partially estimated.



In 1938, shipments of rolled and finished steel products by U. S. Steel Corporation subsidiaries were about 1,000,000 tons less than in 1931. However, largely because of higher prices and differences in the types of products sold, sales and other revenues were approximately $60,000,000 higher than in 1931.

But in 1938

Payroll was up	$22,000,000
Goods and Services Purchased were up	40,000,000
Depreciation and Depletion were up	2,000,000
Taxes were up	14,000,000
making a total increase in costs of	$78,000,000

with the result that

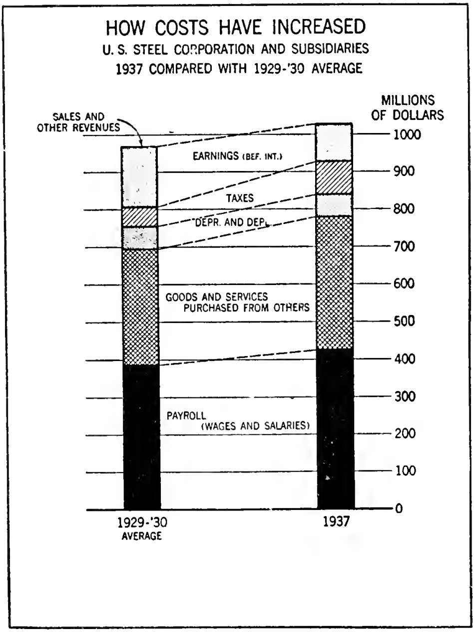
Earnings before Interest were down	$18,000,000

How costs have increased—U. S. Steel Corporation and subsidiaries—1937 compared with 1929–'30 average

Item	1929–'30 Average	1937	Per Cent Increase '37 over '29–'30
Payroll (Wages and Salaries)	$387,416,114	$426,330,944	10
Goods and Services Purchased from Others	306,010,460	353,434,790	16
Depreciation and Depletion	60,912,142	60,861,212	.....
Taxes (Federal, State and Local)	51,511,936	88,048,237	71
Sales and Other Revenues	$967,149,950	$1,028,760,629	6
Earnings (Before Interest)	161,299,298	100,085,446	−38
Rolled and Finished Steel Products Shipped (Tons)	13,429,325	12,789,841	−5

Payroll represents wages and salaries paid to all employees of all companies. The relatively small construction payroll has been excluded as constituting capital expenditures subsequently recoverable through depreciation charges.

Sales and other revenues represent the total amount available for the payment of all expenses and other obligations. In eliminating inter-company business, amounts applicable to transportation companies were partially estimated.



In 1937, shipments of rolled and finished steel products by U. S. Steel Corporation subsidiaries were about 640,000 tons less than the average of 1929-'30. However, largely because of higher prices and differences in the types of products sold, sales and other revenues were approximately $62,000,000 higher than in 1929-'30.

But in 1937

Payroll was up	$39,000,000
Goods and Services Purchased were up	47,000,000
Taxes were up	37,000,000
making a total increase in costs of	$123,000,000
with the result that	
Earnings before Interest were down	$61,000,000

Composite mill net yield and cost per weighted ton shipped—U. S. Steel Corporation and subsidiaries

[1926=100]

Year	Composite Mill Net Yield											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1926	99.8	100.0	99.6	100.2	100.1	99.8	99.8	99.5	99.9	99.6	99.9	99.8
1927	98.7	98.0	97.0	96.6	95.9	96.4	96.3	96.3	95.9	94.9	95.2	93.5
1928	93.4	93.4	93.3	93.4	94.3	93.8	92.9	92.4	92.7	92.9	93.9	93.7
1929	94.2	94.2	93.9	94.3	94.2	94.3	95.0	95.4	94.5	94.3	94.3	94.0
1930	92.4	91.6	91.2	89.9	88.9	88.0	86.6	86.0	85.0	83.7	83.3	82.0
1931	82.2	83.2	82.3	81.8	81.4	80.4	79.9	79.8	81.9	80.0	81.3	80.2
1932	78.6	79.1	79.3	78.7	77.7	79.2	79.5	79.3	79.0	78.8	78.2	77.9
1933	77.0	76.0	76.6	75.0	74.5	74.6	73.5	75.0	77.2	79.4	82.6	83.5
1934	87.1	88.1	87.4	87.1	88.5	87.4	91.8	92.9	91.9	93.3	92.5	89.9
1935	92.1	92.0	91.9	91.9	92.0	91.2	90.5	90.8	90.0	89.6	88.8	89.6
1936	89.0	89.1	87.6	86.4	87.1	88.2	87.3	88.1	88.8	89.6	90.0	90.6
1937	91.4	92.3	93.3	95.8	98.0	99.8	101.6	101.9	103.4	105.7	104.8	105.3
1938	105.4	105.1	105.9	104.3	104.4	102.7	97.9	96.2	95.9	93.7	91.6	92.2
1939	93.2	94.1	95.8	95.1	94.8	92.1	91.4	91.4	91.4	92.2	93.0	------

The composite mill net yield index represents the amount, relative to that for 1926, received per ton by U. S. Steel Corporation subsidiaries (after freight) from sales of a representative constant assortment of all principal products.

Year	Cost per Weighted Ton Shipped		Year	Cost per Weighted Ton Shipped	
	Actual Cost	Estimated Cost at 1926 Volume		Actual Cost	Estimated Cost at 1926 Volume
1926	100.0	100.0	1933	105.8	85.1
1927	103.6	101.1	1934	115.0	92.0
1928	98.3	97.2	1935	112.7	96.6
1929	91.8	92.0	1936	105.9	99.6
1930	96.9	92.8	1937	108.7	106.3
1931	105.6	92.2	1938	124.5	107.6
1932	129.6	91.7			

Actual cost per weighted ton shipped is total cost, exclusive of bond interest, Federal income taxes, miscellaneous non-operating income and expense, and of inter-company items, for all subsidiaries of U. S. Steel Corporation, divided by the number of weighted tons shipped. Weighted tonnages are actual tonnages, adjusted for change in proportions of high and low cost products and for the equivalent tonnage of average cost rolled and finished steel products represented by products other than steel. The cost of operations not related to the production of steel is included in total cost, but since such cost is a small percentage of the total and since the other operations tend to expand and contract with the volume of steel production, the relative change in the total cost per weighted ton may be considered fairly indicative of the change in the cost of producing steel.

Estimated cost if 1926 volume maintained is the actual cost per weighted ton shipped adjusted to 1926 volume on the assumption that the percentage change in the average cost per ton as the result of a given change in volume would have been the same in each of the respective years as it is estimated to have been under 1938 conditions.

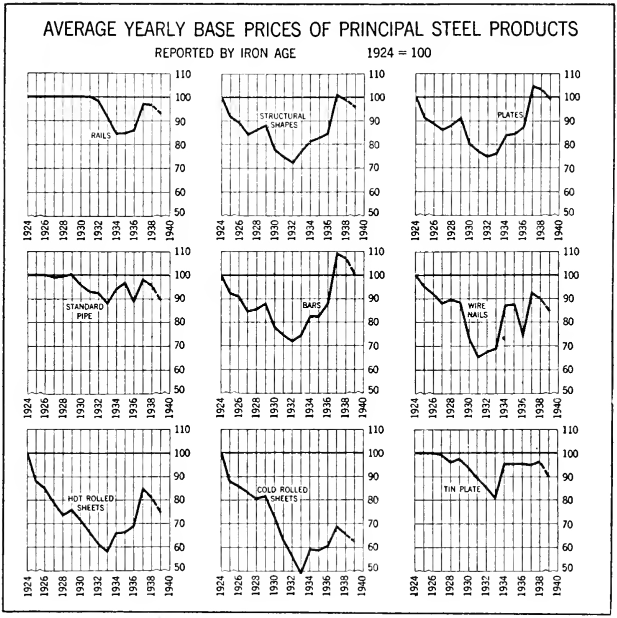
SECTION C—PRICES

Average yearly base prices of principal steel products—reported by Iron Age

Year	Rails		Structural Shapes		Plates		Standard Pipe		Bars	
	Dollars per Gross Ton	1924 =100	Cents per Pound	1924 =100	Cents per Pound	1924 =100	Dollars per Net Ton	1924 =100	Cents per Pound	1924 =100
1924	43.00	100.0	2.19	100.0	2.12	100.0	70.30	100.0	2.20	100.0
1925	43.00	100.0	1.99	90.9	1.91	90.1	70.30	100.0	2.02	91.8
1926	43.00	100.0	1.95	89.0	1.88	88.7	70.30	100.0	2.00	90.9
1927	43.00	100.0	1.83	83.6	1.82	85.8	69.57	99.0	1.84	83.6
1928	43.00	100.0	1.87	85.4	1.87	88.2	69.84	99.3	1.87	85.0
1929	43.00	100.0	1.92	87.7	1.93	91.0	70.30	100.0	1.92	87.3
1930	43.00	100.0	1.69	77.2	1.69	79.7	67.45	95.9	1.71	77.7
1931	43.00	100.0	1.62	74.0	1.62	76.4	65.29	92.9	1.63	74.1
1932	42.44	98.7	1.57	71.7	1.57	74.1	64.89	92.3	1.57	71.4
1933	39.26	91.3	1.68	76.7	1.61	75.9	61.63	87.7	1.64	74.5
1934	36.37	84.6	1.78	81.3	1.78	84.0	66.32	94.3	1.81	82.3
1935	36.37	84.6	1.80	82.2	1.80	84.9	68.40	97.3	1.81	82.3
1936	36.59	85.1	1.85	84.5	1.85	87.3	62.01	88.2	1.93	87.7
1937	41.86	97.3	2.21	100.9	2.21	104.2	69.17	98.4	2.40	109.1
1938	41.77	97.1	2.17	99.1	2.17	102.4	67.00	95.3	2.35	106.8
1939 [1]	40.00	93.0	2.10	95.9	2.10	99.1	63.00	89.6	2.21	100.5

Year	Wire Nails		Hot Rolled Sheets		Cold Rolled Sheets		Tin Plate	
	Dollars per Keg	1924=100	Cents per Pound	1924=100	Cents per Pound	1924=100	Dollars per Base Box	1924=100
1924	2.89	100.0	2.79	100.0	5.00	100.0	5.50	100.0
1925	2.72	94.1	2.45	87.8	4.39	87.8	5.50	100.0
1926	2.65	91.7	2.37	84.9	4.30	86.0	5.50	100.0
1927	2.54	87.9	2.20	78.9	4.17	83.4	5.48	99.6
1928	2.58	89.3	2.04	73.1	4.03	80.6	5.25	95.5
1929	2.57	88.9	2.12	76.0	4.06	81.2	5.35	97.3
1930	2.10	72.7	1.99	71.3	3.64	72.8	5.19	94.4
1931	1.88	65.1	1.86	66.7	3.13	62.6	4.94	89.8
1932	1.95	67.5	1.71	61.3	2.80	56.0	4.69	85.3
1933	1.99	68.9	1.62	58.1	2.48	49.6	4.43	80.5
1934	2.52	87.2	1.85	66.3	2.96	59.2	5.25	95.5
1935	2.53	87.5	1.85	66.3	2.95	59.0	5.25	95.5
1936	2.13	73.7	1.92	68.8	3.02	60.4	5.25	95.5
1937	2.67	92.4	2.35	84.2	3.49	69.8	5.22	94.9
1938	2.60	90.0	2.25	80.6	3.31	66.2	5.31	96.5
1939 [1]	2.44	84.4	2.08	74.6	3.13	62.6	5.00	90.9

[1] Data for 1939 are on basis of first 8 months.



Considerable flexibility exists in steel prices. Not only do steel prices fluctuate widely but, also, prices of different steel products fluctuate in varying degree and direction.

As compared with 1924, prices of steel today are generally lower, whereas wage rates are roughly 30% higher.

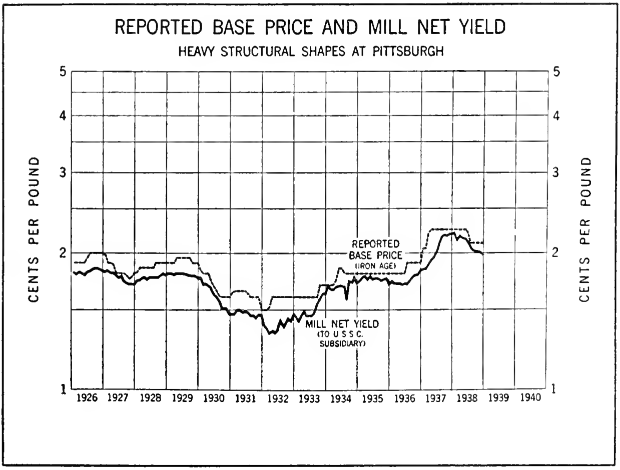
Reported base price and mill net yield—heavy structural shapes at Pittsburgh

[Cents per pound]

	Base Price	Mill Yield
1926		
Jan	1.90	1.81
Feb	1.90	1.79
Mar	1.90	1.81
Apr	1.90	1.80
May	1.90	1.78
Jun	1.94	1.81
Jul	2.00	1.82
Aug	2.00	1.84
Sep	2.00	1.85
Oct	2.00	1.85
Nov	2.00	1.84
Dec	2.00	1.83
1927		
Jan	1.98	1.82
Feb	1.90	1.83
Mar	1.90	1.80
Apr	1.88	1.81
May	1.80	1.78
Jun	1.80	1.76
Jul	1.80	1.78
Aug	1.80	1.73
Sep	1.78	1.72
Oct	1.75	1.71
Nov	1.77	1.71
Dec	1.80	1.71
1928		
Jan	1.81	1.74
Feb	1.85	1.74
Mar	1.85	1.76
Apr	1.85	1.77
May	1.85	1.75
Jun	1.85	1.77
Jul	1.85	1.77
Aug	1.90	1.77
Sep	1.90	1.77
Oct	1.90	1.78
Nov	1.90	1.80
Dec	1.90	1.79
1929		
Jan	1.90	1.80
Feb	1.90	1.80
Mar	1.90	1.79
Apr	1.95	1.80
May	1.95	1.80
Jun	1.95	1.80
Jul	1.95	1.80
Aug	1.95	1.79
Sep	1.95	1.78
Oct	1.90	1.78
Nov	1.90	1.78
Dec	1.90	1.76
1930		
Jan	1.83	1.77
Feb	1.80	1.70
Mar	1.80	1.71
Apr	1.80	1.70
May	1.73	1.68
Jun	1.69	1.63
Jul	1.65	1.61
Aug	1.61	1.57
Sep	1.60	1.52
Oct	1.60	1.51
Nov	1.60	1.51
Dec	1.60	1.47
1931		
Jan	1.64	1.47
Feb	1.65	1.47
Mar	1.65	1.50
Apr	1.65	1.50
May	1.65	1.48
Jun	1.65	1.49
Jul	1.63	1.48
Aug	1.60	1.46
Sep	1.60	1.46
Oct	1.60	1.44
Nov	1.60	1.47
Dec	1.50	1.46
1932		
Jan	1.50	1.39
Feb	1.50	1.37
Mar	1.52	1.33
Apr	1.60	1.35
May	1.60	1.34
Jun	1.60	1.36
Jul	1.60	1.42
Aug	1.60	1.37
Sep	1.60	1.40
Oct	1.60	1.44
Nov	1.60	1.42
Dec	1.60	1.47
1933		
Jan	1.60	1.45
Feb	1.60	1.42
Mar	1.60	1.46
Apr	1.60	1.49
May	1.60	1.46
Jun	1.60	1.46
Jul	1.60	1.46
Aug	1.60	1.48
Sep	1.60	1.55
Oct	1.70	1.59
Nov	1.70	1.63
Dec	1.70	1.63
1934		
Jan	1.70	1.70
Feb	1.70	1.67
Mar	1.70	1.66
Apr	1.74	1.68
May	1.85	1.69
Jun	1.85	1.70
Jul	1.81	1.69
Aug	1.80	1.57
Sep	1.80	1.74
Oct	1.80	1.73
Nov	1.80	1.77
Dec	1.80	1.72
1935		
Jan	1.80	1.74
Feb	1.80	1.77
Mar	1.80	1.78
Apr	1.80	1.75
May	1.80	1.78
Jun	1.80	1.75
Jul	1.80	1.76
Aug	1.80	1.76
Sep	1.80	1.74
Oct	1.80	1.75
Nov	1.80	1.76
Dec	1.80	1.71
1936		
Jan	1.80	1.74
Feb	1.80	1.72
Mar	1.80	1.72
Apr	1.80	1.72
May	1.80	1.71
Jun	1.80	1.72
Jul	1.90	1.71
Aug	1.90	1.73
Sep	1.90	1.77
Oct	1.90	1.79
Nov	1.90	1.79
Dec	1.90	1.83
1937		
Jan	2.05	1.84
Feb	2.05	1.85
Mar	2.21	1.88
Apr	2.25	1.93
May	2.25	1.95
Jun	2.25	2.00
Jul	2.25	2.10
Aug	2.25	2.17
Sep	2.25	2.19
Oct	2.25	2.18
Nov	2.25	2.20
Dec	2.25	2.20
1938		
Jan	2.25	2.22
Feb	2.25	2.14
Mar	2.25	2.18
Apr	2.25	2.16
May	2.25	2.15
Jun	2.22	2.12
Jul	2.10	2.05
Aug	2.10	2.02
Sep	2.10	2.01
Oct	2.10	2.01
Nov	2.10	2.00
Dec	2.10	1.98

Base prices are as reported by Iron Age and are monthly averages of weekly figures.

Mill net yield is an average of yields at Clairton and Homestead plants of U. S. Steel Corporation subsidiary which represent net sales of heavy structural shapes to domestic market (after freight) divided by number of tons shipped, converted to cents per pound.



Base prices of heavy structural shapes at Pittsburgh, as reported by Iron Age, have shown considerable flexibility since 1926.

There has been even more fluctuation in the mill net yield, that is, the amount per pound actually received by the U. S. Steel Corporation subsidiary after deduction of cost of delivery. Such mill net yield declined 25% from the high of 1929 to the low of 1932. The increases in prices in 1937 were the result of increased wages and other costs.

Factors tending to lower mill net yield with respect to reported base price are principally (a) reductions from base price, and (b) excess of actual cost of delivery over freight added to base price in computing the delivered price. Factors tending to raise mill net yield with respect to reported base price are principally (a) extras for special finish, quality, size, heat treatment, etc., and (b) extras for small quantity.

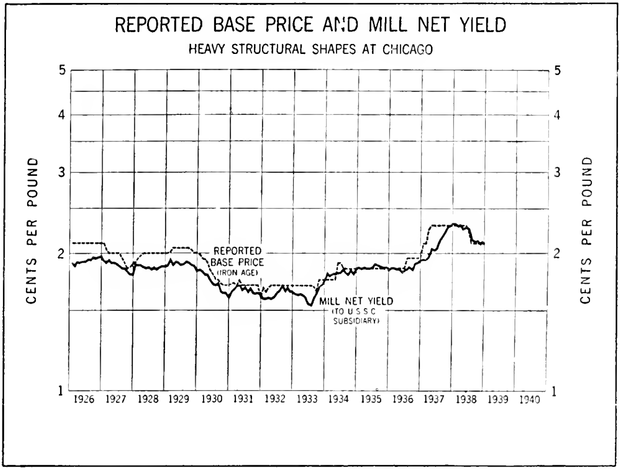
Reported base price and mill net yield—Heavy structural shapes at Chicago

[Cents per pound]

	Base Price	Mill Yield
1926		
Jan	2.10	1.90
Feb	2.10	1.87
Mar	2.10	1.91
Apr	2.10	1.90
May	2.10	1.91
Jun	2.10	1.91
Jul	2.10	1.93
Aug	2.10	1.93
Sep	2.10	1.96
Oct	2.10	1.95
Nov	2.10	1.96
Dec	2.10	1.97
1927		
Jan	2.10	1.92
Feb	2.03	1.90
Mar	2.00	1.93
Apr	2.00	1.90
May	2.00	1.90
Jun	2.00	1.89
Jul	2.00	1.87
Aug	1.94	1.85
Sep	1.90	1.85
Oct	1.85	1.82
Nov	1.87	1.79
Dec	1.90	1.79
1928		
Jan	1.91	1.89
Feb	1.95	1.88
Mar	1.98	1.88
Apr	2.00	1.86
May	2.00	1.85
Jun	2.00	1.86
Jul	2.00	1.84
Aug	2.00	1.86
Sep	2.00	1.84
Oct	2.00	1.86
Nov	2.00	1.87
Dec	2.00	1.87
1929		
Jan	2.00	1.88
Feb	2.01	1.94
Mar	2.05	1.88
Apr	2.05	1.91
May	2.05	1.90
Jun	2.05	1.88
Jul	2.05	1.89
Aug	2.05	1.91
Sep	2.05	1.90
Oct	2.03	1.88
Nov	2.00	1.87
Dec	2.00	1.83
1930		
Jan	1.99	1.84
Feb	1.95	1.82
Mar	1.94	1.79
Apr	1.90	1.79
May	1.83	1.75
Jun	1.79	1.71
Jul	1.75	1.70
Aug	1.75	1.72
Sep	1.71	1.65
Oct	1.70	1.64
Nov	1.70	1.64
Dec	1.70	1.60
1931		
Jan	1.71	1.65
Feb	1.72	1.67
Mar	1.70	1.69
Apr	1.75	1.70
May	1.70	1.66
Jun	1.70	1.69
Jul	1.70	1.64
Aug	1.70	1.68
Sep	1.70	1.64
Oct	1.70	1.63
Nov	1.70	1.64
Dec	1.60	1.62
1932		
Jan	1.68	1.58
Feb	1.65	1.58
Mar	1.68	1.59
Apr	1.70	1.58
May	1.70	1.60
Jun	1.70	1.63
Jul	1.70	1.66
Aug	1.70	1.70
Sep	1.70	1.65
Oct	1.70	1.68
Nov	1.70	1.65
Dec	1.70	1.65
1933		
Jan	1.70	1.63
Feb	1.70	1.62
Mar	1.70	1.63
Apr	1.70	1.62
May	1.77	1.59
Jun	1.70	1.54
Jul	1.70	1.53
Aug	1.69	1.60
Sep	1.65	1.63
Oct	1.75	1.69
Nov	1.75	1.71
Dec	1.75	1.75
1934		
Jan	1.75	1.80
Feb	1.75	1.78
Mar	1.75	1.80
Apr	1.75	1.80
May	1.90	1.81
Jun	1.90	1.81
Jul	1.86	1.84
Aug	1.85	1.81
Sep	1.85	1.79
Oct	1.85	1.83
Nov	1.85	1.80
Dec	1.85	1.85
1935		
Jan	1.85	1.86
Feb	1.85	1.85
Mar	1.85	1.86
Apr	1.85	1.85
May	1.85	1.85
Jun	1.85	1.86
Jul	1.85	1.89
Aug	1.85	1.88
Sep	1.85	1.87
Oct	1.85	1.84
Nov	1.85	1.86
Dec	1.85	1.83
1936		
Jan	1.85	1.85
Feb	1.85	1.85
Mar	1.85	1.84
Apr	1.85	1.84
May	1.85	1.81
Jun	1.85	1.83
Jul	1.95	1.84
Aug	1.95	1.87
Sep	1.95	1.84
Oct	1.95	1.90
Nov	1.95	1.91
Dec	1.95	1.93
1937		
Jan	2.10	1.94
Feb	2.10	1.94
Mar	2.25	1.96
Apr	2.20	2.04
May	2.30	2.03
Jun	2.30	2.05
Jul	2.30	2.12
Aug	2.30	2.16
Sep	2.30	2.21
Oct	2.30	2.28
Nov	2.30	2.29
Dec	2.30	2.32
1938		
Jan	2.30	2.32
Feb	2.30	2.29
Mar	2.30	2.31
Apr	2.30	2.25
May	2.30	2.27
Jun	2.26	2.24
Jul	2.10	2.14
Aug	2.10	2.11
Sep	2.10	2.12
Oct	2.10	2.09
Nov	2.10	2.12
Dec	2.10	2.11

Base prices are as reported by Iron Age and are monthly averages of weekly figures.

Mill net yield is that of South Chicago plant of U. S. Steel Corporation subsidiary, and represents net sales of heavy structural shapes to domestic market (after freight) divided by number of tons shipped, converted to cents per pound.



Base prices of heavy structural shapes at Chicago, as reported by Iron Age, have shown considerable flexibility since 1926.

There has been even more fluctuation in the mill net yield, i. e., the amount per pound actually received by the U. S. Steel Corporation subsidiary after deduction of cost of delivery. Such mill net yield declined 24% from the high of 1929 to the low of 1933. The increases in prices in 1937 were the result of increased wages and other costs.

Factors tending to lower mill net yield with respect to reported base price are principally (a) deductions from base price and (b) excess of actual cost of delivery over freight added to base price in computing delivered price. Factors tending to raise mill net yield with respect to reported base price are principally (a) extras for special finish, quality, size, heat treatment, etc., and (b) extras for small quantity.

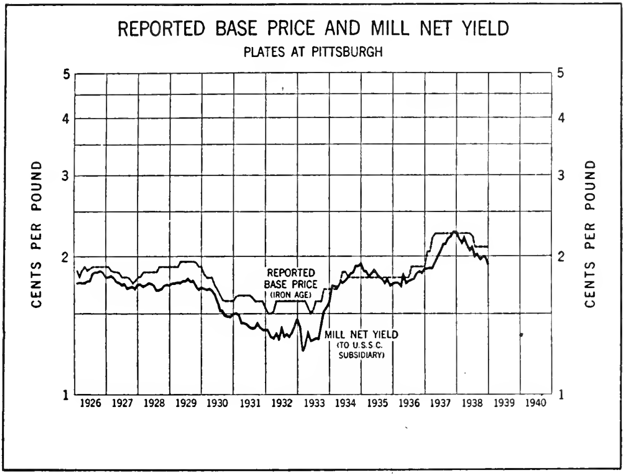
Reported base price and mill net yield—Plates at Pittsburgh

[Cents per pound]

	Base Price	Mill Net Yield
1926		
Jan	1.86	1.75
Feb	1.80	1.76
Mar	1.86	1.75
Apr	1.90	1.75
May	1.86	1.77
Jun	1.88	1.77
Jul	1.90	1.84
Aug	1.90	1.85
Sep	1.90	1.85
Oct	1.90	1.86
Nov	1.90	1.84
Dec	1.90	1.80
1927		
Jan	1.90	1.80
Feb	1.86	1.82
Mar	1.85	1.79
Apr	1.85	1.76
May	1.84	1.75
Jun	1.80	1.73
Jul	1.80	1.74
Aug	1.80	1.70
Sep	1.78	1.71
Oct	1.75	1.72
Nov	1.77	1.70
Dec	1.80	1.73
1928		
Jan	1.81	1.74
Feb	1.85	1.72
Mar	1.85	1.73
Apr	1.85	1.75
May	1.85	1.74
Jun	1.85	1.73
Jul	1.85	1.68
Aug	1.90	1.69
Sep	1.90	1.70
Oct	1.90	1.73
Nov	1.90	1.74
Dec	1.90	1.73
1929		
Jan	1.90	1.75
Feb	1.90	1.75
Mar	1.90	1.76
Apr	1.95	1.75
May	1.95	1.77
Jun	1.95	1.77
Jul	1.95	1.79
Aug	1.95	1.76
Sep	1.95	1.77
Oct	1.94	1.72
Nov	1.90	1.69
Dec	1.90	1.71
1930		
Jan	1.83	1.70
Feb	1.80	1.69
Mar	1.80	1.70
Apr	1.80	1.68
May	1.73	1.65
Jun	1.69	1.59
Jul	1.65	1.52
Aug	1.61	1.53
Sep	1.60	1.48
Oct	1.60	1.47
Nov	1.60	1.47
Dec	1.60	1.50
1931		
Jan	1.64	1.51
Feb	1.65	1.49
Mar	1.65	1.43
Apr	1.65	1.43
May	1.65	1.42
Jun	1.65	1.40
Jul	1.63	1.39
Aug	1.60	1.40
Sep	1.60	1.43
Oct	1.60	1.40
Nov	1.60	1.38
Dec	1.54	1.38
1932		
Jan	1.50	1.38
Feb	1.50	1.34
Mar	1.52	1.33
Apr	1.60	1.36
May	1.60	1.32
Jun	1.60	1.40
Jul	1.60	1.34
Aug	1.60	1.36
Sep	1.60	1.34
Oct	1.60	1.37
Nov	1.60	1.41
Dec	1.60	1.47
1933		
Jan	1.60	1.41
Feb	1.60	1.22
Mar	1.60	1.30
Apr	1.55	1.36
May	1.50	1.31
Jun	1.53	1.32
Jul	1.60	1.33
Aug	1.60	1.33
Sep	1.60	1.42
Oct	1.70	1.52
Nov	1.70	1.55
Dec	1.70	1.59
1934		
Jan	1.70	1.73
Feb	1.70	1.72
Mar	1.70	1.72
Apr	1.74	1.77
May	1.85	1.75
Jun	1.85	1.77
Jul	1.81	1.80
Aug	1.80	1.84
Sep	1.80	1.85
Oct	1.80	1.91
Nov	1.80	1.91
Dec	1.80	1.93
1935		
Jan	1.80	1.86
Feb	1.80	1.86
Mar	1.80	1.81
Apr	1.80	1.84
May	1.80	1.87
Jun	1.80	1.83
Jul	1.80	1.80
Aug	1.80	1.78
Sep	1.80	1.75
Oct	1.80	1.79
Nov	1.80	1.73
Dec	1.80	1.75
1936		
Jan	1.80	1.76
Feb	1.80	1.76
Mar	1.80	1.73
Apr	1.80	1.83
May	1.80	1.75
Jun	1.80	1.77
Jul	1.90	1.78
Aug	1.90	1.79
Sep	1.90	1.84
Oct	1.90	1.86
Nov	1.90	1.84
Dec	1.90	1.88
1937		
Jan	2.05	1.88
Feb	2.05	1.89
Mar	2.21	1.89
Apr	2.25	1.94
May	2.25	2.01
Jun	2.25	2.06
Jul	2.25	2.13
Aug	2.25	2.14
Sep	2.25	2.20
Oct	2.25	2.22
Nov	2.25	2.27
Dec	2.25	2.26
1938		
Jan	2.25	2.19
Feb	2.25	2.14
Mar	2.25	2.21
Apr	2.25	2.13
May	2.25	2.07
Jun	2.22	2.11
Jul	2.10	2.00
Aug	2.10	2.03
Sep	2.10	1.97
Oct	2.10	2.00
Nov	2.10	2.00
Dec	2.10	1.92

Base prices are as reported by Iron Age and are monthly averages of weekly figures.

Mill net yield is that of Homestead plant of U. S. Steel Corporation subsidiary and represents net sales of sheared plates to domestic market (after freight) divided by number of tons shipped, converted to cents per pound.



Base prices of plates, as reported by Iron Age, have shown considerable flexibility since 1926.

There has been even more fluctuation in the mill net yield, that is, the amount per pound actually received by the U. S. Steel Corporation subsidiary after deduction of cost of delivery. Such mill net yield declined 32% from the high of 1929 to the low of 1933. The increases in prices in 1937 were the result of increased wages and other costs.

Factors tending to lower mill net yield with respect to reported base price are principally (a) reductions from base price, and (b) excess of actual cost of delivery over freight added to base price in computing the delivered price. Factors tending to raise mill net yield with respect to reported base price are principally (a) extras for special finish, quality, size, heat treatment, etc., and (b) extras for small quantity.

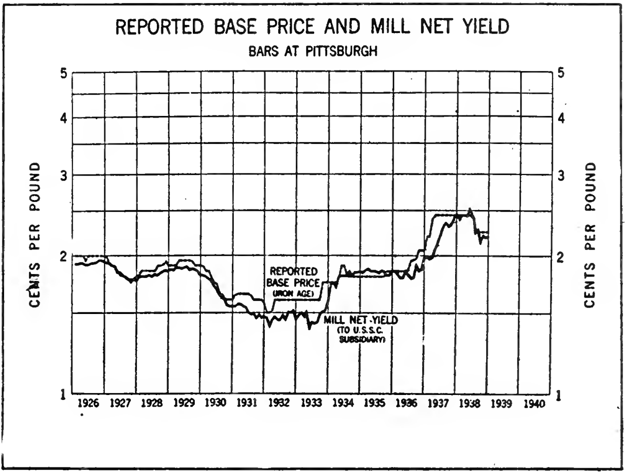
Reported base price and mill net yield—Bars at Pittsburgh

[Cents per pound]

	Base Price	Mill Yield
1926		
Jan	2.00	1.92
Feb	2.00	1.92
Mar	2.00	1.93
Apr	2.00	1.93
May	1.95	1.91
Jun	2.00	1.91
Jul	2.00	1.93
Aug	2.00	1.93
Sep	2.00	1.94
Oct	2.00	1.96
Nov	2.00	1.96
Dec	2.00	1.95
1927		
Jan	1.98	1.93
Feb	1.90	1.93
Mar	1.90	1.90
Apr	1.89	1.89
May	1.85	1.84
Jun	1.81	1.84
Jul	1.80	1.81
Aug	1.80	1.79
Sep	1.78	1.77
Oct	1.75	1.77
Nov	1.77	1.77
Dec	1.80	1.76
1928		
Jan	1.81	1.79
Feb	1.85	1.80
Mar	1.85	1.80
Apr	1.85	1.80
May	1.85	1.81
Jun	1.85	1.80
Jul	1.85	1.82
Aug	1.90	1.81
Sep	1.90	1.83
Oct	1.91	1.84
Nov	1.94	1.86
Dec	1.90	1.85
1929		
Jan	1.90	1.87
Feb	1.90	1.86
Mar	1.90	1.88
Apr	1.95	1.88
May	1.95	1.87
Jun	1.95	1.88
Jul	1.95	1.89
Aug	1.95	1.86
Sep	1.94	1.87
Oct	1.90	1.86
Nov	1.90	1.85
Dec	1.80	1.82
1930		
Jan	1.89	1.81
Feb	1.85	1.80
Mar	1.85	1.78
Apr	1.79	1.76
May	1.75	1.72
Jun	1.73	1.69
Jul	1.65	1.64
Aug	1.64	1.62
Sep	1.61	1.60
Oct	1.60	1.56
Nov	1.60	1.55
Dec	1.60	1.55
1931		
Jan	1.64	1.55
Feb	1.65	1.57
Mar	1.65	1.57
Apr	1.65	1.55
May	1.65	1.54
Jun	1.65	1.50
Jul	1.63	1.49
Aug	1.60	1.50
Sep	1.60	1.46
Oct	1.60	1.49
Nov	1.60	1.46
Dec	1.58	1.47
1932		
Jan	1.50	1.46
Feb	1.50	1.40
Mar	1.52	1.45
Apr	1.60	1.47
May	1.60	1.45
Jun	1.60	1.45
Jul	1.60	1.48
Aug	1.60	1.45
Sep	1.60	1.51
Oct	1.60	1.50
Nov	1.60	1.52
Dec	1.60	1.45
1933		
Jan	1.60	1.48
Feb	1.60	1.50
Mar	1.60	1.47
Apr	1.60	1.51
May	1.60	1.38
Jun	1.60	1.43
Jul	1.60	1.42
Aug	1.60	1.43
Sep	1.60	1.49
Oct	1.75	1.51
Nov	1.75	1.52
Dec	1.75	1.58
1934		
Jan	1.75	1.73
Feb	1.75	1.75
Mar	1.75	1.71
Apr	1.79	1.80
May	1.90	1.81
Jun	1.90	1.81
Jul	1.82	1.81
Aug	1.80	1.85
Sep	1.80	1.81
Oct	1.80	1.84
Nov	1.80	1.84
Dec	1.80	1.85
1935		
Jan	1.80	1.84
Feb	1.80	1.86
Mar	1.80	1.87
Apr	1.80	1.85
May	1.80	1.85
Jun	1.80	1.85
Jul	1.80	1.83
Aug	1.80	1.86
Sep	1.80	1.85
Oct	1.85	1.81
Nov	1.85	1.81
Dec	1.85	1.85
1936		
Jan	1.85	1.85
Feb	1.85	1.82
Mar	1.85	1.79
Apr	1.85	1.79
May	1.85	1.85
Jun	1.85	1.81
Jul	1.95	1.78
Aug	1.95	1.79
Sep	1.97	1.90
Oct	2.05	1.85
Nov	2.05	1.87
Dec	2.05	1.98
1937		
Jan	2.20	1.99
Feb	2.20	1.97
Mar	2.40	1.98
Apr	2.45	2.06
May	2.45	2.13
Jun	2.45	2.22
Jul	2.45	2.32
Aug	2.45	2.36
Sep	2.45	2.31
Oct	2.45	2.33
Nov	2.45	2.40
Dec	2.45	2.46
1938		
Jan	2.45	2.39
Feb	2.45	2.45
Mar	2.45	2.45
Apr	2.45	2.43
May	2.45	2.53
Jun	2.41	2.42
Jul	3.25	2.24
Aug	2.25	2.28
Sep	2.25	2.14
Oct	2.25	2.22
Nov	2.25	2.19
Dec	2.25	2.20

Base prices are as reported by Iron Age and are monthly averages of weekly figures.

Mill net yield is that of Duquesne plant of U. S. Steel Corporation subsidiary and represents net sales of bars, rounds, etc., O. H., to domestic market (after freight) divided by number of tons shipped, converted to cents per pound.



Base prices of bars at Pittsburgh, as reported by Iron Age, have shown considerable flexibility since 1926.

There has been even more fluctuation in the mill net yield, that is, the amount per pound actually received by the U. S. Steel Corporation subsidiary after deduction of cost of delivery. Such mill net yield declined 27% from the high of 1929 to the low of 1933. The increases in prices in 1937 were the result of increased wages and other costs.

Factors tending to lower mill net yield with respect to reported base price are principally (a) reductions from base price, (b) excess of actual cost of delivery over freight added to base price in computing the delivered price, and (c) quantity discounts. Factors tending to raise mill net yield with respect to reported base price are principally (a) extras for special finish, quality, size, heat treatment, etc., and (b) extras for small quantity.

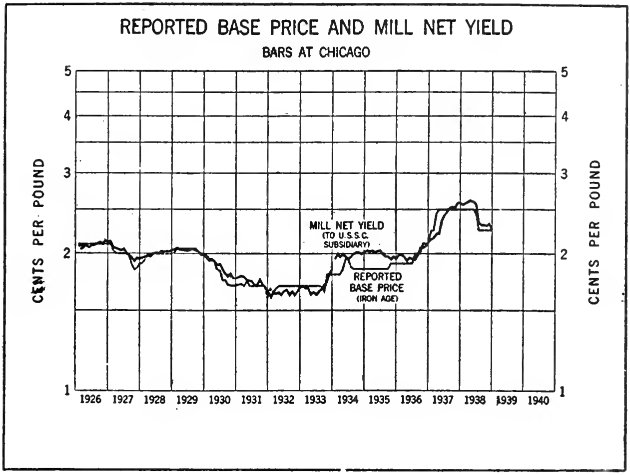
Reported base price and mill net yield—bars at Chicago

[Cents per pound]

	Base Price	Mill Net Yield
1926		
Jan	2.10	2.08
Feb	2.10	2.09
Mar	2.10	2.08
Apr	2.10	2.08
May	2.10	2.06
Jun	2.10	2.09
Jul	2.10	2.09
Aug	2.10	2.11
Sep	2.10	2.12
Oct	2.10	2.10
Nov	2.10	2.13
Dec	2.10	2.12
1927		
Jan	2.10	2.13
Feb	2.03	2.06
Mar	2.00	2.05
Apr	2.00	2.04
May	2.00	2.03
Jun	2.00	2.05
Jul	2.00	2.00
Aug	1.98	1.98
Sep	1.90	1.96
Oct	1.85	1.93
Nov	1.87	1.96
Dec	1.90	1.95
1928		
Jan	1.91	1.96
Feb	1.95	1.97
Mar	1.98	1.98
Apr	2.00	1.97
May	2.00	2.00
Jun	2.00	2.01
Jul	2.00	2.00
Aug	2.00	2.03
Sep	2.00	2.02
Oct	2.00	2.03
Nov	2.00	2.03
Dec	2.00	2.04
1929		
Jan	2.00	2.05
Feb	2.01	2.06
Mar	2.05	2.04
Apr	2.05	2.04
May	2.05	2.03
Jun	2.05	2.03
Jul	2.05	2.04
Aug	2.05	2.05
Sep	2.05	2.03
Oct	2.03	2.03
Nov	2.00	1.99
Dec	2.00	1.99
1930		
Jan	1.99	1.96
Feb	1.95	1.93
Mar	1.95	1.94
Apr	1.91	1.93
May	1.85	1.89
Jun	1.83	1.90
Jul	1.75	1.85
Aug	1.75	1.81
Sep	1.71	1.78
Oct	1.70	1.81
Nov	1.70	1.77
Dec	1.70	1.77
1931		
Jan	1.71	1.78
Feb	1.72	1.79
Mar	1.70	1.78
Apr	1.75	1.76
May	1.70	1.75
Jun	1.70	1.74
Jul	1.70	1.70
Aug	1.70	1.71
Sep	1.70	1.76
Oct	1.70	1.71
Nov	1.70	1.69
Dec	1.60	1.66
1932		
Jan	1.68	1.61
Feb	1.65	1.65
Mar	1.68	1.64
Apr	1.70	1.65
May	1.70	1.63
Jun	1.70	1.66
Jul	1.70	1.67
Aug	1.70	1.63
Sep	1.70	1.66
Oct	1.70	1.63
Nov	1.70	1.66
Dec	1.70	1.69
1933		
Jan	1.70	1.70
Feb	1.70	1.68
Mar	1.70	1.68
Apr	1.70	1.63
May	1.70	1.65
Jun	1.70	1.63
Jul	1.70	1.65
Aug	1.69	1.67
Sep	1.65	1.71
Oct	1.80	1.73
Nov	1.80	1.81
Dec	1.80	1.85
1934		
Jan	1.80	1.95
Feb	1.80	2.00
Mar	1.80	1.97
Apr	1.84	2.00
May	1.95	1.97
Jun	1.95	1.95
Jul	1.87	1.97
Aug	1.85	2.00
Sep	1.85	2.02
Oct	1.85	2.02
Nov	1.85	2.00
Dec	1.85	2.01
1935		
Jan	1.85	2.03
Feb	1.85	2.02
Mar	1.85	2.03
Apr	1.85	2.01
May	1.85	2.02
Jun	1.85	2.03
Jul	1.85	1.99
Aug	1.85	1.97
Sep	1.85	1.97
Oct	1.90	1.94
Nov	1.90	1.97
Dec	1.90	1.95
1936		
Jan	1.90	1.99
Feb	1.90	1.99
Mar	1.90	1.97
Apr	1.90	1.93
May	1.90	1.96
Jun	1.90	1.95
Jul	2.00	1.94
Aug	2.00	1.98
Sep	2.00	2.06
Oct	2.10	2.06
Nov	2.10	2.07
Dec	2.10	2.11
1937		
Jan	2.25	2.15
Feb	2.25	2.17
Mar	2.45	2.21
Apr	2.50	2.21
May	2.50	2.37
Jun	2.50	2.43
Jul	2.50	2.48
Aug	2.50	2.52
Sep	2.50	2.53
Oct	2.50	2.52
Nov	2.50	2.59
Dec	2.50	2.59
1938		
Jan	2.50	2.56
Feb	2.50	2.58
Mar	2.50	2.60
Apr	2.50	2.61
May	2.50	2.60
Jun	2.45	2.57
Jul	2.25	2.34
Aug	2.25	2.31
Sep	2.25	2.31
Oct	2.25	2.30
Nov	2.25	2.33
Dec	2.25	2.26

Base prices are as reported by Iron Age and are monthly averages of weekly figures.

Mill net yield is that of Gary plant of U. S. Steel Corporation subsidiary and represents net sales of bars, rounds, etc., O. H., to domestic market (after freight) divided by number of tons shipped, converted to cents per pound; classification broadened January, 1934.



Base prices of bars at Chicago, as reported by Iron Age, have shown considerable flexibility since 1926.

There has been even more fluctuation in the mill net yield, that is, the amount per pound actually received by the U. S. Steel Corporation after deduction of cost of delivery. Such mill net yield declined 22% from the high of 1929 to the low of 1932. The increases in prices in 1937 were the result of increased wages and other costs.

Factors tending to lower mill net yield with respect to reported base price are principally (a) reductions from base price, (b) excess of actual cost of delivery over freight added to base price in computing the delivered price, and (c) quantity discounts. Factors tending to raise mill net yield with respect to reported base price are principally (a) extras for special finish, quality, size, heat treatment, etc., and (b) extras for small quantity.

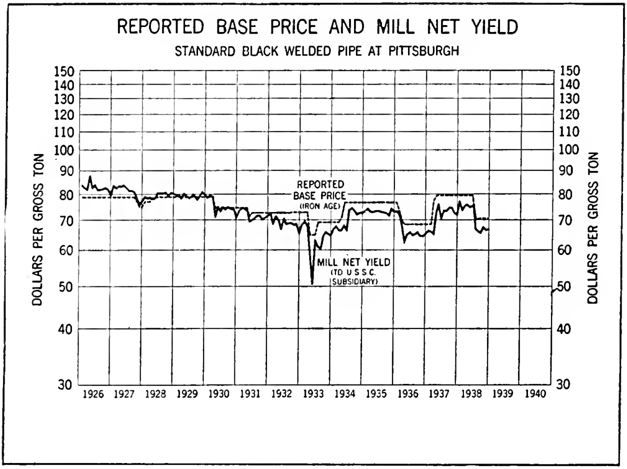
Reported base price and mill net yield—standard black welded pipe at Pittsburgh

[Dollars per gross ton]

	Base Price	Mill Net Yield
1926		
Jan	78.74	83.59
Feb	78.74	82.41
Mar	78.74	81.71
Apr	78.74	87.70
May	78.74	82.46
Jun	78.74	83.46
Jul	78.74	81.51
Aug	78.74	81.73
Sep	78.74	82.05
Oct	78.74	82.43
Nov	78.74	81.90
Dec	78.74	79.43
1927		
Jan	78.74	83.36
Feb	78.74	82.11
Mar	78.74	83.02
Apr	78.74	82.95
May	78.74	83.62
Jun	78.74	82.40
Jul	78.74	81.12
Aug	78.74	81.19
Sep	78.74	80.93
Oct	76.76	78.29
Nov	74.80	75.75
Dec	74.80	77.10
1928		
Jan	76.83	78.60
Feb	76.83	78.11
Mar	76.83	78.47
Apr	78.27	78.00
May	78.74	78.12
Jun	78.74	80.47
Jul	78.74	80.21
Aug	78.74	80.31
Sep	78.74	80.63
Oct	78.74	79.48
Nov	78.74	80.42
Dec	78.74	80.11
1929		
Jan	78.74	79.47
Feb	78.74	79.61
Mar	78.74	78.33
Apr	78.74	80.37
May	78.74	79.34
Jun	78.74	78.11
Jul	78.74	79.29
Aug	78.74	79.26
Sep	78.74	77.52
Oct	78.74	79.02
Nov	78.74	80.75
Dec	78.74	79.87
1930		
Jan	78.74	78.56
Feb	78.74	79.63
Mar	78.74	79.14
Apr	74.48	70.89
May	74.48	74.99
Jun	74.48	73.22
Jul	74.48	74.96
Aug	74.48	74.38
Sep	74.48	75.00
Oct	74.48	74.01
Nov	74.48	73.83
Dec	74.48	70.89
1931		
Jan	74.48	73.54
Feb	74.48	74.26
Mar	74.48	74.18
Apr	74.48	73.39
May	71.22	69.66
Jun	72.62	69.90
Jul	72.62	70.48
Aug	72.62	71.66
Sep	72.62	71.78
Oct	72.62	70.16
Nov	72.62	70.74
Dec	72.62	71.42
1932		
Jan	72.62	72.21
Feb	72.62	68.64
Mar	72.62	71.63
Apr	72.62	70.16
May	72.62	66.88
Jun	72.62	70.49
Jul	72.62	68.43
Aug	72.62	68.83
Sep	72.80	68.82
Oct	72.80	68.22
Nov	72.80	68.64
Dec	72.80	65.25
1933		
Jan	72.80	68.36
Feb	72.80	69.39
Mar	72.80	68.14
Apr	64.96	60.07
May	64.96	50.63
Jun	69.96	63.46
Jul	69.16	61.12
Aug	69.16	60.43
Sep	69.16	64.49
Oct	69.16	65.97
Nov	69.16	65.38
Dec	69.16	64.73
1934		
Jan	69.16	66.80
Feb	69.16	67.78
Mar	69.16	66.34
Apr	71.02	66.33
May	76.61	67.95
Jun	76.61	66.42
Jul	76.61	73.93
Aug	76.61	74.44
Sep	76.61	73.34
Oct	76.61	72.09
Nov	76.61	72.65
Dec	76.61	72.64
1935		
Jan	76.61	73.17
Feb	76.61	74.18
Mar	76.61	73.12
Apr	76.61	72.91
May	76.61	73.30
Jun	76.61	73.34
Jul	76.61	73.02
Aug	76.61	72.92
Sep	76.61	72.62
Oct	76.61	71.43
Nov	76.61	74.14
Dec	76.61	73.36
1936		
Jan	76.61	73.19
Feb	72.78	71.90
Mar	69.22	67.45
Apr	68.32	62.30
May	68.32	65.17
Jun	68.32	65.96
Jul	68.32	64.70
Aug	68.32	65.19
Sep	68.32	65.86
Oct	68.32	64.57
Nov	68.32	64.39
Dec	68.32	65.11
1937		
Jan	68.32	66.18
Feb	68.32	65.99
Mar	77.82	65.27
Apr	79.52	72.38
May	79.52	75.96
Jun	79.52	70.41
Jul	79.52	73.41
Aug	79.52	73.13
Sep	79.52	74.45
Oct	79.52	74.70
Nov	79.52	72.52
Dec	79.52	71.74
1938		
Jan	79.52	76.96
Feb	79.52	73.58
Mar	79.52	75.56
Apr	79.52	75.59
May	79.52	74.83
Jun	79.52	75.11
Jul	70.56	66.76
Aug	70.56	66.00
Sep	70.56	65.58
Oct	70.56	67.32
Nov	70.56	66.50
Dec	70.56	66.70

Base prices are as reported by Iron Age (converted to a gross ton basis) and are monthly averages of weekly figures.

Mill net yield is that of National plant of U. S. Steel Corporation subsidiary and represents net sales of standard black welded pipe to domestic market (after freight) divided by number of tons shipped. This classification of pipe includes some pipe sold on a base different from the base price to which the mill net yield is here compared, but the two base prices show the same general trends and fluctuations.



Base prices of standard black welded pipe, as reported by Iron Age, have shown considerable flexibility since 1926.

There has been even more fluctuation in the mill net yield, i. e., the amount per ton actually received by the U. S. Steel Corporation subsidiary after deduction of cost of delivery. After decreasing gradually from 1926 to 1929, the mill net yield declined 37% from the high of 1929 to the low of 1933. The increases in prices in 1937 were the result of increased wages and other costs.

Factors tending to lower mill net yield with respect to reported base price are principally (a) reductions from base price, (b) excess of actual cost of delivery over freight added to base price in computing the delivered price, (c) quantity discounts and (d) deductions for quality, size, etc. Factors tending to raise mill net yield with respect to reported base price are principally (a) extras for special finish, quality, size, steel treatment, etc., and (b) extras for small quantity.

Reported base price and mill net yield—cold rolled sheets

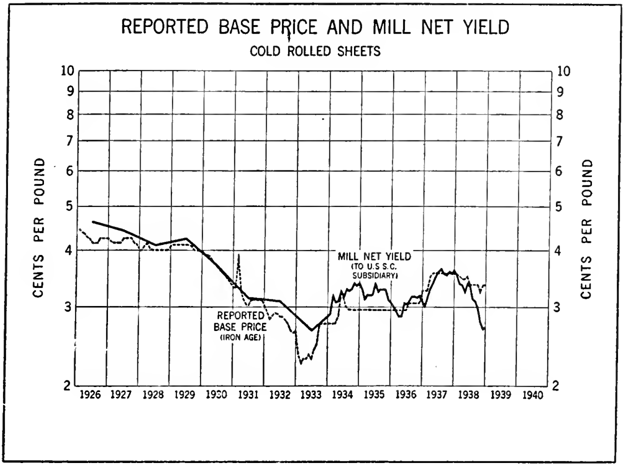
[Cents per pound]

	Base Price	Mill Yield
1926		
Jan	4.45	[1] 4.61
Feb	4.38	
Mar	4.35	
Apr	4.28	
May	4.24	
Jun	4.15	
Jul	4.15	
Aug	4.15	
Sep	4.25	
Oct	4.25	
Nov	4.25	
Dec	4.25	
1927		
Jan	4.18	[1] 4.41
Feb	4.15	
Mar	4.15	
Apr	4.15	
May	4.15	
Jun	4.25	
Jul	4.25	
Aug	4.25	
Sep	4.25	
Oct	4.15	
Nov	4.12	
Dec	4.00	
1928		
Jan	4.00	[1] 4.09
Feb	4.08	
Mar	4.15	
Apr	4.04	
May	4.00	
Jun	4.00	
Jul	4.00	
Aug	4.00	
Sep	4.00	
Oct	4.00	
Nov	4.00	
Dec	4.08	
1929		
Jan	4.10	[1] 4.23
Feb	4.10	
Mar	4.10	
Apr	4.10	
May	4.10	
Jun	4.10	
Jul	4.10	
Aug	4.08	
Sep	4.00	
Oct	4.00	
Nov	4.00	
Dec	3.98	
1930		
Jan	3.90	[1] 3.68
Feb	3.90	
Mar	3.88	
Apr	3.80	
May	3.75	[1] 3.68
June	3.65	
Jul	3.60	
Aug	3.60	
Sep	3.50	
Oct	3.45	
Nov	3.38	
Dec	3.30	
1931		
Jan	3.30	[1] 3.12
Feb	3.90	
Mar	3.24	
Apr	3.10	
May	3.03	
Jun	3.02	
Jul	3.10	
Aug	3.10	
Sep	3.10	
Oct	3.10	
Nov	3.10	
Dec	3.02	
1932		
Jan	2.90	[1] 3.07
Feb	2.80	
Mar	2.86	
Apr	2.90	
May	2.89	
Jun	2.85	
Jul	2.85	
Aug	2.81	
Sep	2.75	
Oct	2.65	
Nov	2.63	
Dec	2.65	
1933		
Jan	2.35	[1] 2.66
Feb	2.25	
Mar	2.30	
Apr	2.30	
May	2.34	
Jun	2.29	
Jul	2.40	
Aug	2.47	
Sep	2.75	
Oct	2.75	
Nov	2.75	
Dec	2.75	
1934		
Jan	2.75	2.88
Feb	2.75	3.17
Mar	2.75	3.06
Apr	2.85	3.08
May	3.15	3.23
Jun	3.15	3.16
Jul	2.99	3.27
Aug	2.95	3.25
Sep	2.95	3.28
Oct	2.95	3.38
Nov	2.95	3.34
Dec	2.95	3.39
1935		
Jan	2.95	3.26
Feb	2.95	3.10
Mar	2.95	3.18
Apr	2.95	3.17
May	2.95	3.19
Jun	2.95	3.36
Jul	2.95	3.24
Aug	2.95	3.27
Sep	2.95	3.27
Oct	2.95	3.27
Nov	2.95	3.10
Dec	2.95	3.06
1936		
Jan	2.95	3.00
Feb	2.95	2.93
Mar	2.95	2.85
Apr	2.95	2.85
May	2.95	3.05
Jun	2.95	3.03
Jul	3.05	3.07
Aug	3.05	3.15
Sep	3.05	3.15
Oct	3.05	3.13
Nov	3.05	3.17
Dec	3.25	3.08
1937		
Jan	3.25	3.00
Feb	3.25	3.12
Mar	3.49	3.27
Apr	3.55	3.35
May	3.55	3.48
Jun	3.55	3.57
Jul	3.55	3.63
Aug	3.55	3.54
Sep	3.55	3.52
Oct	3.55	3.58
Nov	3.55	3.54
Dec	3.55	3.61
1938		
Jan	3.55	3.54
Feb	3.50	3.36
Mar	3.45	3.35
Apr	3.45	3.24
May	3.50	3.38
Jun	3.35	3.32
Jul	3.35	3.12
Aug	3.35	3.08
Sep	3.35	2.97
Oct	3.23	2.78
Nov	3.35	2.67
Dec	3.35	2.69

[1] Yearly average.

Base prices are as reported by Iron Age and are monthly averages of weekly figures. Iron Age data are for 20-gauge cold rolled sheets at Pittsburgh from September 1926 to April 1938; data prior and subsequent to that period have been adjusted to that gauge.

Mill net yield is a weighted average of yields of plants of U. S. Steel Corporation subsidiaries, which represents net sales of cold rolled and automobile sheets to domestic market (after freight) divided by number of tons shipped, converted to cents per pound. Data are for plants of American Sheet and Tin Plate Company prior to 1937, and thereafter for Vandergrift and Gary plants of Carnegie-Illinois Steel Corporation.



Base prices of cold-rolled sheets, as reported by Iron Age, have declined considerably since 1926 as well as having shown considerable fluctuation during the period.

The monthly mill net yield, i. e., the amount per pound received by the U. S. Steel Corporation subsidiary after deduction of cost of delivery, has shown even more fluctuation than the published base price. The mill net yield curve prior to 1934 appears to fluctuate less than the reported base price because it is based on annual averages, monthly data not being available.

Over the period the mill net yield has declined from an average of 4.61¢ per pound in 1926 to a 1938 low of 2.67¢ per pound, a decrease of 42%.

Factors tending to lower mill net yield with respect to reported base price are principally (a) reductions from base price, (b) excess of actual cost of delivery over freight added to base price in computing the delivered price, (c) quantity discounts and (d) deductions for quality, size, etc. Factors tending to raise mill net yield with respect to reported base price are principally (a) extras for special finish, quality, size, heat treatment, etc., and (b) extras for small quantity.

Reported composite price and composite mill net yield

[1926=100]

	Composite Price	Mill Net Yield
1926		
Jan	100.3	99.8
Feb	100.0	100.0
Mar	100.3	99.6
Apr	100.1	100.2
May	99.5	100.1
Jun	99.7	99.8
Jul	100.0	99.8
Aug	100.0	99.5
Sep	100.0	99.9
Oct	100.0	99.6
Nov	100.0	99.9
Dec	100.0	99.8
1927		
Jan	98.5	98.7
Feb	95.9	98.0
Mar	96.5	97.0
Apr	96.2	96.6
May	95.7	95.9
Jun	95.5	96.4
Jul	95.4	96.3
Aug	95.4	96.3
Sep	95.0	95.9
Oct	93.0	94.9
Nov	92.1	95.2
Dec	92.1	93.5
1928		
Jan	92.3	93.4
Feb	93.7	93.4
Mar	94.1	93.3
Apr	94.0	93.4
May	93.0	94.3
Jun	93.0	93.8
Jul	92.6	92.9
Aug	93.3	92.4
Sep	93.3	92.7
Oct	93.7	92.9
Nov	94.2	93.9
Dec	94.5	93.7
1929		
Jan	94.7	94.2
Feb	94.7	94.2
Mar	94.7	93.9
Apr	96.0	94.3
May	96.2	94.2
Jun	96.6	94.3
Jul	96.2	95.0
Aug	95.6	95.4
Sep	95.4	94.5
Oct	94.9	94.3
Nov	94.7	94.3
Dec	95.2	94.0
1930		
Jan	93.4	92.4
Feb	92.8	91.6
Mar	92.7	91.2
Apr	90.6	89.9
May	88.8	88.9
Jun	88.2	88.0
Jul	87.2	86.6
Aug	86.3	86.0
Sep	85.9	85.0
Oct	85.6	83.7
Nov	85.4	83.3
Dec	84.8	82.0
1931		
Jan	85.4	82.2
Feb	85.6	83.2
Mar	85.6	82.3
Apr	85.3	81.8
May	85.3	81.4
Jun	84.8	80.4
Jul	84.4	79.9
Aug	84.0	79.8
Sep	84.0	81.9
Oct	84.0	80.0
Nov	83.8	81.3
Dec	82.5	80.2
1932		
Jan	81.2	78.6
Feb	81.1	79.1
Mar	81.2	79.3
Apr	82.4	78.7
May	82.4	77.7
Jun	82.4	79.2
Jul	82.7	79.5
Aug	82.7	79.3
Sep	82.7	79.0
Oct	82.5	78.8
Nov	82.0	78.2
Dec	82.0	77.9
1933		
Jan	81.4	77.0
Feb	80.9	76.0
Mar	80.6	76.6
Apr	78.5	75.0
May	77.8	74.5
Jun	78.6	74.6
Jul	81.1	73.5
Aug	81.3	75.0
Sep	81.6	77.2
Oct	84.2	79.4
Nov	83.5	82.6
Dec	84.0	83.5
1934		
Jan	84.0	87.1
Feb	84.0	88.1
Mar	84.0	87.4
Apr	85.9	87.1
May	91.5	88.5
Jun	91.5	87.4
Jul	88.8	91.8
Aug	88.8	92.9
Sep	88.8	91.9
Oct	88.8	93.3
Nov	88.8	92.5
Dec	88.8	89.9
1935		
Jan	88.8	92.1
Feb	88.8	92.0
Mar	88.8	91.9
Apr	88.8	91.9
May	88.8	92.0
Jun	88.8	91.2
Jul	88.8	90.5
Aug	88.8	90.8
Sep	88.8	90.0
Oct	89.1	89.6
Nov	89.1	88.8
Dec	89.1	89.6
1936		
Jan	89.1	89.0
Feb	88.1	89.1
Mar	87.3	87.6
Apr	87.6	86.4
May	87.6	87.1
Jun	87.8	88.2
Jul	90.3	87.3
Aug	90.3	88.1
Sep	90.5	88.8
Oct	91.4	89.6
Nov	91.4	90.0
Dec	95.0	90.6
1937		
Jan	97.1	91.4
Feb	97.1	92.3
Mar	106.2	93.3
Apr	108.5	95.8
May	108.5	98.0
Jun	108.5	99.8
Jul	108.5	101.6
Aug	108.5	101.9
Sep	108.5	103.4
Oct	108.5	105.7
Nov	108.5	104.8
Dec	108.5	105.3
1938		
Jan	108.5	105.4
Feb	108.5	105.1
Mar	108.5	105.9
Apr	108.5	104.3
May	108.3	104.4
Jun	106.2	102.7
Jul	99.4	97.9
Aug	99.4	96.2
Sep	99.0	95.9
Oct	97.4	93.7
Nov	98.7	91.6
Dec	98.7	92.2
1939		
Jan	98.7	93.2
Feb	98.7	94.1
Mar	98.7	95.8
Apr	98.7	95.1
May	97.5	94.8
Jun	96.6	92.1

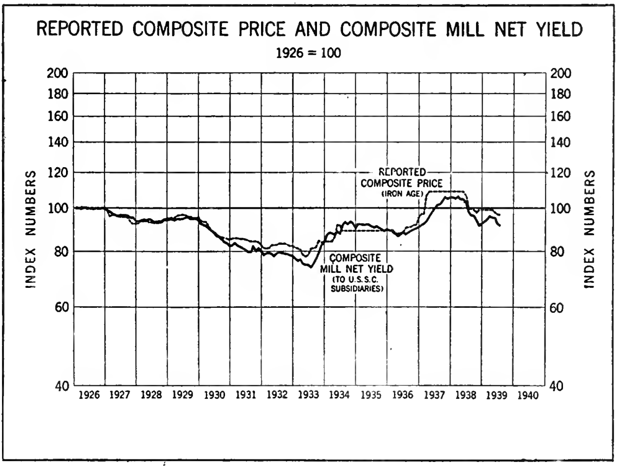
Reported composite price and composite mill net yield—Continued

[1926=100]

	Composite Price	Mill Net Yield		Composite Price	Mill Net Yield		Composite Price	Mill Net Yield
	1939							
Jul	96.6	91.4						
Aug								
Sep								
Oct								
Nov								
Dec								

The reported composite price index is based upon the Iron Age composite price, which is an arithmetic average of the reported base prices of eight representative finished steel products.

The composite mill net yield index represents the amount, relative to that for 1926, received per ton by U. S. Steel Corporation subsidiaries (after freight) from sales of a representative constant assortment of all principal products.



Base prices of steel, as indicated by the composite price reported by Iron Age, have shown considerable flexibility since 1926.

There has been even more fluctuation in the mill net yield, i. e., the amount received per ton by the U. S.Steel Corporation subsidiaries on the various products after deduction of cost of delivery. The mill net yield index declined from an average of 100 in 1926 to a low of 73.5 in 1933. The increases in prices in 1937 were the result of increased wages and other costs.

Factors tending to lower mill net yields with respect to reported base prices are principally (a) reductions from base price, (b) excess of actual cost of delivery over freight added to base price in computing the delivered price, (c) quantity discounts and (d) deductions for quality, size, etc. Factors tending to raise mill net yield with respect to reported base prices are principally (a) extras for special finish, quality, size, heat treatment, etc., and (b) extras for small quantity.

Reported composite price and composite mill net yield

[1926=100]

	Composite Price	Mill Net Yield		Composite Price	Mill Net Yield		Composite Price	Mill Net Yield
	1912			1916			1920	
Jan	61.5	57.9	Jan	89.0	67.3	Jan	152.7	122.2
Feb	60.5	57.3	Feb	95.2	68.7	Feb	152.7	122.2
Mar	60.2	57.5	Mar	105.7	71.0	Mar	164.2	122.3
Apr	61.9	57.6	Apr	112.8	74.2	Apr	170.9	123.5
May	62.9	58.1	May	118.8	77.3	May	168.0	124.0
Jun	63.5	58.4	Jun	116.2	79.2	Jun	166.3	123.8
Jul	65.0	58.3	Jul	114.0	82.3	Jul	169.1	124.4
Aug	67.1	58.9	Aug	115.9	84.0	Aug	172.7	124.8
Sep	69.5	59.6	Sep	119.4	86.0	Sep	170.8	125.1
Oct	71.7	60.8	Oct	123.4	88.2	Oct	162.5	126.1
Nov	73.4	60.9	Nov	130.5	90.8	Nov	154.2	125.8
Dec	74.5	61.9	Dec	141.6	93.6	Dec	133.1	126.5
	1913			1917			1921	
Jan	76.5	63.3	Jan	146.2	98.8	Jan	129.1	126.1
Feb	76.3	64.3	Feb	151.2	103.5	Feb	123.1	126.5
Mar	77.1	65.2	Mar	161.5	107.3	Mar	115.9	126.6
Apr	77.3	65.7	Apr	177.5	111.9	Apr	114.0	118.7
May	74.6	66.0	May	197.1	115.4	May	114.5	114.6
Jun	72.9	66.4	Jun	216.2	118.7	Jun	109.0	113.6
Jul	72.0	66.2	Jul	230.4	123.3	Jul	102.2	106.1
Aug	70.2	66.1	Aug	226.7	127.5	Aug	96.0	98.7
Sep	68.7	65.9	Sep	218.1	131.5	Sep	93.0	94.6
Oct	67.3	65.3	Oct	149.8	134.4	Oct	91.3	90.4
Nov	65.0	64.2	Nov	148.8	134.2	Nov	88.8	88.1
Dec	63.2	62.9	Dec	148.6	132.8	Dec	86.4	86.9
	1914			1918			1922	
Jan	62.7	61.2	Jan	153.3	139.3	Jan	84.6	85.4
Feb	63.8	60.8	Feb	153.3	137.6	Feb	82.2	84.7
Mar	63.6	61.2	Mar	153.3	136.1	Mar	82.2	82.8
Apr	62.5	61.1	Apr	153.3	135.8	Apr	85.1	82.7
May	61.5	60.5	May	153.3	137.9	May	87.7	82.9
Jun	60.4	59.9	Jun	153.3	138.2	Jun	90.1	83.5
Jul	60.5	59.0	Jul	153.3	139.4	Jul	91.5	84.2
Aug	62.5	59.2	Aug	153.3	139.5	Aug	87.0	85.1
Sep	63.5	59.4	Sep	153.3	140.6	Sep	101.6	86.2
Oct	62.5	59.6	Oct	153.3	142.1	Oct	103.6	87.3
Nov	60.3	59.5	Nov	153.3	142.6	Nov	103.3	88.6
Dec	59.0	58.8	Dec	149.5	140.2	Dec	102.4	90.0
	1915			1919			1923	
Jan	59.7	58.2	Jan	145.6	136.1	Jan	103.7	91.9
Feb	60.3	58.0	Feb	145.6	134.7	Feb	109.5	94.1
Mar	61.0	58.1	Mar	141.8	132.1	Mar	115.5	96.0
Apr	62.1	58.8	Apr	130.9	125.4	Apr	119.9	98.4
May	61.9	59.1	May	130.5	123.9	May	119.7	100.4
Jun	62.4	59.6	Jun	130.5	122.0	Jun	118.6	101.9
Jul	63.5	60.1	Jul	130.5	121.9	Jul	118.6	103.6
Aug	65.3	60.4	Aug	130.5	121.5	Aug	118.6	105.1
Sep	67.3	61.0	Sep	129.8	121.2	Sep	118.6	106.2
Oct	70.6	62.1	Oct	131.8	121.5	Oct	118.6	107.7
Nov	76.4	63.1	Nov	133.2	120.8	Nov	118.6	110.4
Dec	83.8	64.5	Dec	134.3	121.6	Dec	118.0	110.6

Reported composite price and composite mill net yield—Continued

[1926=100]

	Composite Price	Mill Net Yield		Composite Price	Mill Net Yield		Composite Price	Mill Net Yield
	1924			1928			1932	
Jan	118.6	112.6	Jan	92.3	93.4	Jan	81.2	78.6
Feb	117.5	112.7	Feb	93.7	93.4	Feb	81.1	79.1
Mar	115.0	113.0	Mar	94.1	93.3	Mar	81.2	79.3
Apr	112.0	112.6	Apr	94.0	93.4	Apr	82.4	78.7
May	100.2	111.0	May	93.0	94.3	May	82.4	77.7
Jun	108.0	108.3	Jun	93.0	93.8	Jun	82.4	79.2
Jul	105.8	107.3	Jul	92.6	92.9	Jul	82.7	79.5
Aug	103.5	105.3	Aug	93.3	92.4	Aug	82.7	79.3
Sep	101.8	104.2	Sep	93.3	92.7	Sep	82.7	79.0
Oct	101.0	102.0	Oct	93.7	92.9	Oct	82.5	78.8
Nov	101.6	101.4	Nov	94.2	93.9	Nov	82.0	78.2
Dec	103.6	101.2	Dec	94.5	93.7	Dec	82.0	77.9
	1925			1929			1933	
Jan	104.1	101.9	Jan	94.7	94.2	Jan	81.4	77.0
Feb	104.6	102.3	Feb	94.7	94.2	Feb	80.9	76.0
Mar	104.7	102.9	Mar	94.7	93.9	Mar	80.6	76.6
Apr	102.0	103.0	Apr	96.0	94.3	Apr	78.5	75.0
May	100.6	102.3	May	96.2	94.2	May	77.8	74.5
Jun	99.6	100.7	Jun	96.6	94.3	Jun	78.6	74.6
Jul	99.5	100.2	Jul	96.2	95.0	Jul	81.1	73.5
Aug	98.7	100.3	Aug	95.6	95.4	Aug	81.3	75.0
Sep	97.7	99.7	Sep	95.4	94.5	Sep	81.6	77.2
Oct	98.3	99.7	Oct	94.9	94.3	Oct	84.2	79.4
Nov	99.8	99.5	Nov	94.7	94.3	Nov	83.5	82.6
Dec	100.6	99.6	Dec	95.2	94.0	Dec	84.0	83.5
	1926			1930			1934	
Jan	100.3	99.8	Jan	93.4	92.4	Jan	84.0	87.1
Feb	100.0	100.0	Feb	92.8	91.6	Feb	84.0	88.1
Mar	100.3	99.6	Mar	92.7	91.2	Mar	84.0	87.4
Apr	100.1	100.2	Apr	90.6	89.9	Apr	85.9	87.1
May	99.5	100.1	May	88.8	88.9	May	91.5	88.5
Jun	99.7	99.8	Jun	88.2	88.0	Jun	91.5	87.4
Jul	100.0	99.8	Jul	87.2	86.6	Jul	88.8	91.8
Aug	100.0	99.5	Aug	86.3	86.0	Aug	88.8	92.9
Sep	100.0	99.9	Sep	85.9	85.0	Sep	88.8	91.9
Oct	100.0	99.6	Oct	85.6	83.7	Oct	88.8	93.3
Nov	100.0	99.9	Nov	85.4	83.3	Nov	88.8	92.5
Dec	100.0	99.8	Dec	84.8	82.0	Dec	88.8	89.9
	1927			1931			1935	
Jan	98.5	98.7	Jan	85.4	82.2	Jan	88.8	92.1
Feb	95.9	98.0	Feb	85.6	83.2	Feb	88.8	92.0
Mar	96.5	97.0	Mar	85.6	82.3	Mar	88.8	91.9
Apr	96.2	96.6	Apr	85.3	81.8	Apr	88.8	91.9
May	95.7	95.9	May	85.3	81.4	May	88.8	92.0
Jun	95.5	96.4	Jun	84.8	80.4	Jun	88.8	91.2
Jul	95.4	96.3	Jul	84.4	79.9	Jul	88.8	90.5
Aug	95.4	96.3	Aug	84.0	79.8	Aug	88.8	90.8
Sep	95.0	95.9	Sep	84.0	81.9	Sep	88.8	90.0
Oct	93.0	94.9	Oct	84.0	80.0	Oct	89.1	89.6
Nov	92.1	95.2	Nov	83.8	81.3	Nov	89.1	88.8
Dec	92.1	93.5	Dec	82.5	80.2	Dec	89.1	89.6

Reported composite price and composite mill net yield—Continued

[1926=100]

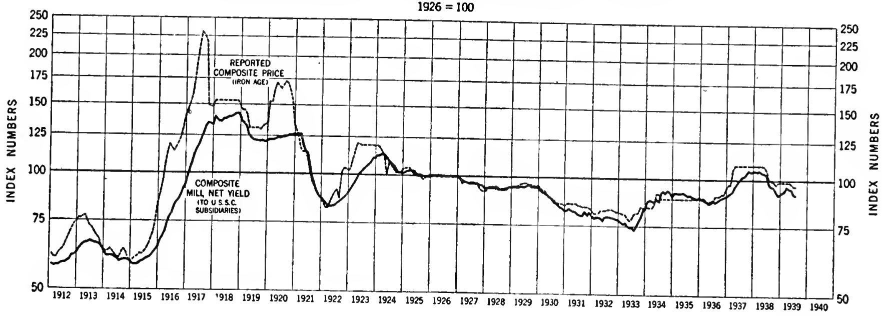
	Composite Price	Mill Net Yield
1936		
Jan	89.1	89.0
Feb	88.1	89.1
Mar	87.3	87.6
Apr	87.6	86.4
May	87.6	87.1
Jun	87.8	88.2
Jul	90.3	87.3
Aug	90.3	88.1
Sep	90.5	88.8
Oct	91.4	89.6
Nov	91.4	90.0
Dec	95.0	90.6
1937		
Jan	97.1	91.4
Feb	97.1	92.3
Mar	106.2	93.3
Apr	108.5	95.8
May	108.5	98.0
Jun	108.5	99.8
Jul	108.5	101.6
Aug	108.5	101.9
Sep	108.5	103.4
Oct	108.5	105.7
Nov	108.5	104.8
Dec	108.5	105.3
1938		
Jan	108.5	105.4
Feb	108.5	105.1
Mar	108.5	105.9
Apr	108.5	104.3
May	108.3	104.4
Jun	106.2	102.7
Jul	99.4	97.9
Aug	99.4	96.2
Sep	99.0	95.9
Oct	97.4	93.7
Nov	98.7	91.6
Dec	98.7	92.2
1939		
Jan	98.7	93.2
Feb	98.7	94.1
Mar	98.7	95.8
Apr	98.7	95.1
May	97.5	94.8
Jun	96.6	92.1
Jul	96.6	91.4

The reported composite price index is based upon the Iron Age composite price which is an arithmetic average of the reported base prices of eight representative finished steel products.

The composite mill net yield index represents the amount per ton, relative to that for 1926, received by U. S. Steel Corporation subsidiaries (after freight) on a representative constant assortment of all principal products.

REPORTED COMPOSITE PRICE AND COMPOSITE MILL NET YIELD

1926 = 100



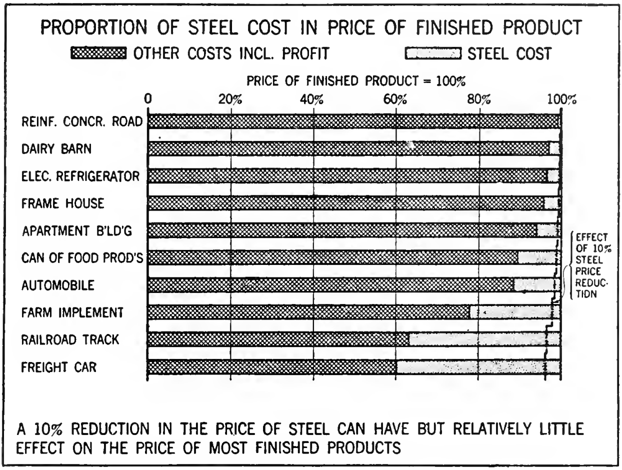
Ordinarily the general level of the reported steel prices, as indicated by the Iron Age composite price of steel, reflects the relative level of the mill net yields, i. e., the amounts received per ton by the U. S. Steel Corporation subsidiaries on the various products after deduction of cost of delivery. However, at times the level of the mill net yields has been slightly above or slightly below the relative level of the reported prices, except that during the periods of intense demand during the Word War and in 1920 when the prices charged by the Corporation's subsidiaries were beneath the level of the going prices.

Factors tending to lower mill net yields with respect to reported base prices are principally (a) reductions from base price, (b) excess of actual cost of delivery over freight added to base price in computing the delivered price, (c) quantity discounts and (d) deductions for quality, size, etc. Factors tending to raise mill net yields with respect to reported base prices are principally (a) extras for special finish, quality, size, heat treatment, etc., and (b) extras for small quantity.

Proportion of steel cost in price of finished product, 1938—typical products of important steel consuming industries

Product	Estimated Price	Estimated Cost of Steel	Steel Cost in % of Price	Remarks
Reinforced Concrete Road.	$55,000	$400	0.7	One mile of twenty foot concrete highway in Indiana. Steel cost is cost of 16,000 pounds of reinforcing bars.
Dairy Barn	$2,600	$83	3.2	Roof sizes 30′ x 60′. Steel cost is cost of galvanized sheets for roof only, and excludes other items such as nails, staples, etc.
Electric Refrigerator	$218	$7	3.4	Six cu. ft. capacity refrigerator. Steel cost is cost of 200 pounds of steel, principally sheets, and excludes steel in motor and refrigerating unit.
Frame House	$4,000	$172	4.3	Typical small four room dwelling. Steel cost is cost of 8,000 pounds of radiators, boiler, water tank, pipe, metal lath, nails, gutters, conduit, etc.
Apartment Building	$938,000	$55,077	5.9	Six story fire-proof, walk-up apartment house in N. Y. Steel cost is cost of fabricated but unerected structural steel.
Can of Food Products	11.8¢	1.22¢	10.4	Average price of cans of tomatoes, peas and corn in N. Y. Steel cost is cost of tin plate.
Automobile	$730	$77	10.5	Typical low-priced four door sedan delivered in N. Y. Steel cost is cost of 2,800 pounds of sheets, strip, pig iron, bars, etc.
Farm Implement	$112	$25	22.3	Average of fifteen low-priced farm implements. Steel cost estimate is based on average weight, and steel cost of $60 per ton.
Railroad Track	$33,400	$12,300	36.8	One mile of new track, including ballast, ties, rails and fastenings. Steel cost is cost of rails and fastenings.
Freight Car	$2,250	$898	39.9	Typical 50 ton capacity hopper car. Steel cost is cost of 38,000 pounds of plates, shapes, wheels, axles, etc.

Above data are necessarily estimates but are believed to reflect, with reasonable accuracy, the proportion of steel cost in the price of the finished product.

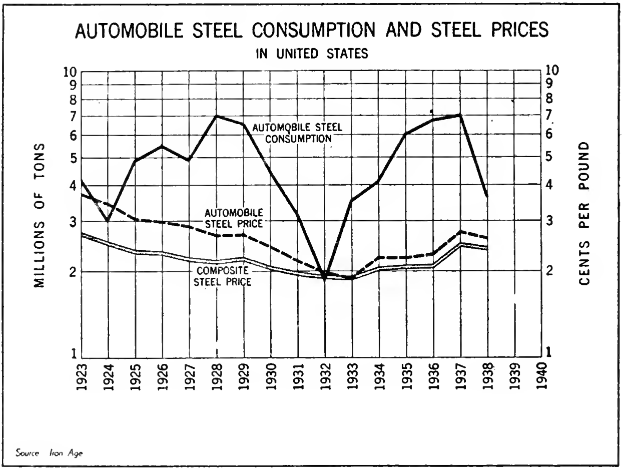


The cost of steel is a relatively small part of the price of most finished products. For example, the cost of the steel in a low-priced automobile averages about 10% of the delivered price to the ultimate consumer Consequently, a 10% reduction in the cost of steel, if entirely passed on to the consumer, would reduce the price only 1%.

Automobile steel consumption and steel prices in United States

Year	Automobile Steel Consumption (Thous. Gr. Tons)	Automobile Steel Price (Cents per Pound)	Composite Steel Price (Cents per Pound)	Year	Automobile Steel Consumption (Thous. Gr. Tons)	Automobile Steel Price (Cents per Pound)	Composite Steel Price (Cents per Pound)
1923	4,182	3.73	2.697	1931	3,149	2.18	1.957
1924	2,981	3.45	2.505	1932	1,864	1.98	1.901
1925	4,886	3.04	2.334	1933	3,530	1.89	1.879
1926	5,486	2.99	2.315	1934	4,101	2.22	2.033
1927	4,895	2.88	2.202	1935	6,016	2.22	2.058
1928	6,963	2.67	2.165	1936	6,712	2.28	2.077
1929	6,545	2.69	2.209	1937	6,977	2.73	2.464
1930	4,406	2.44	2.048	1938	3,619	2.60	2.394

Source: Automobile steel consumption data are based on figures of Iron Age. Steel price figures are from Iron Age, automobile steel price data representing average of prices of hot rolled strip and hot and cold rolled sheets.

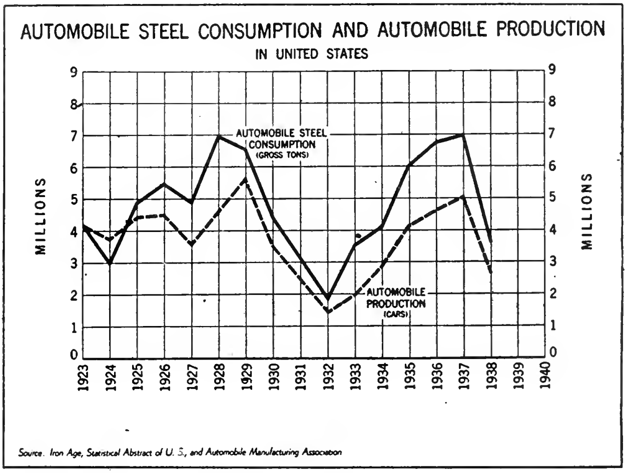


Automobile steel consumption and steel prices have little, if any, relation to each other. Hence, factors other than steel prices must govern automobile steel consumption.

Automobile steel consumption and automobile production in United States

Year	Automobile Steel Consumption (Thous. Gr. Tons)	Automobile Production (Thous. Cars)	Year	Automobile Steel Consumption (Thous. Gr. Tons)	Automobile Production (Thous. Cars)
1923	4, 182	4, 180	1931	3, 149	2, 472
1924	2, 981	3, 738	1932	1, 864	1, 431
1925	4, 886	4, 428	1933	3, 530	1, 986
1926	5, 486	4, 506	1934	4, 101	2, 870
1927	4, 895	3, 580	1935	6, 016	4, 120
1928	6, 963	4, 601	1936	6, 712	4, 616
1929	6, 545	5, 622	1937	6, 977	5, 016
1930	4, 406	3, 510	1938	3, 619	2, 655

Source: Automobile steel consumption data are based on figures of Iron Age. Automobile production data are from Statistical Abstract of the United States, and Automobile Manufacturing Association.



Production of automobile steel is closely associated with and dependent upon production of automobiles. Accordingly, the demand for automobile steel is determined by factors which govern the demand for automobiles, rather than by factors, such as price of automobile steel, within the control of the steel industry.

The Basing Point Method of Quoting Delivered Prices in the Steel Industry

The basing point practice in the steel industry is a simple method of quoting delivered prices, which results in the competition of many geographically separated steel producers at the markets for each of the diversified products of modern steel mills. It is not a price-fixing medium nor does it result in high prices. It does not stifle price competition but rather extends the benefits of such competition to all consumers.

This basing point practice has evolved over a period of more than half a century to meet fundamental economic conditions in the steel industry. Delivered prices result from the buyer's need to know the cost to him of steel delivered at his plant, since transportation charges from mill to consumer are often a substantial part of the value at the place of consumption.

The producer of steel must take into consideration all of the elements of cost involved, from the transportation of raw materials, through the processes of converting such raw materials into steel products, to the final delivery of such products to the consumer. It requires more than four tons of raw materials to produce one ton of finished steel. The location of facilities for producing pig iron and steel ingots must be determined largely by the factor of raw material assembly costs. This limits the location of blast furnaces and open hearth furnaces to a few areas where the raw materials are readily available. In turn, the economies of integration cause the location of rolling mills near the steel producing units. Large well-integrated mills, designed to supply the scattered markets of the entire country, have been constructed in such areas. These mills produce many diversified products in order to utilize ingot capacity to the fullest extent and achieve low production cost per unit. A modern integrated mill must serve more than its immediate area; it must reach many of the important markets for its diversified products in order to obtain an even flow of orders. Thus, concentration of production facilities in a few areas and wide distribution of products is a rule in the steel industry enforced by economic considerations. The result is competition at all consuming points between several geographically separated producers.

The demand for steel is subject to enormous fluctuations in the business cycle. The capacity of the industry, including reserve capacity, is not more than sufficient to supply the needs of the country during periods of high demand, such as 1929, 1937 and the present time. Less capacity would result in scarcity and high prices during such periods. The problem of adjustment to the fluctuations of the business cycle is solved in the most economical way. While the industry is constantly constructing new facilities to incorporate technological advances, the older mills which, although outmoded, have not served their full useful life, are retained in reserve to meet the demand at high levels of consumption.

Most criticisms of the basing point method disregard entirely these fundamental economic facts. The steel industry is often judged by criteria derived from abstract theory, based upon imaginary conditions which cannot exist. Natural deviations from these criteria are arbitrarily assumed to be evils and are, without demonstration, ascribed to the basing point method. Critics sometimes rest their case solely upon bland assertions and rhetorical exaggeration. In many instances, mere name-calling is resorted to. Thus, in the language of some critics, the practice of meeting competitive prices at a distance becomes "freight absorption"; the resulting difference in mill net returns becomes "price discrimination"; the resulting shipments from other than the mill nearest the destination becomes "cross-hauling"; and the realization of a competitive advantage due to superior geographical location becomes "phantom freight."

Competitive forces determine the prices quoted at all destinations. To obtain business in a market at a distance from his mill, a producer must meet competitive prices quoted by other producers nearer to such markets; he must pay the freight necessary to transport the steel product to the consumer; and he will therefore realize a lower mill net return than on sales to consumers nearer his mill. This enables him to operate his mill at a lower unit cost and thus to sell to the nearby consumer for less than he otherwise could.

There will always be some shipments of similar products past each other in opposite directions unless competition between geographically separated producers is arbitrarily limited to the marginal territory between their mills. Even under the uniform f. o. b. mill price system proposed by the Federal Trade Commission, shipments would not always be made from the nearest mill. The alleged economic waste resulting from cross-shipments must be balanced against the countervailing advantages to the public of a competitive system, and also against

the economic losses which would follow from artificial limitation of marketing territories.

If an isolated producer is located nearer than other producers to an important market, he will be able to realize a higher mill net return. In so doing, he may be merely taking proper advantage of his superior geographical location, or he may need such higher return to compensate for his additional costs in assembling and processing raw materials. He can obtain higher mill net returns than some of his competitors either by announcing a higher price at his mill, or by merely meeting the competitive delivered prices of other producers. Characterizing the latter practice as the collection of freight charges which are not paid is a distortion of the facts.

Transportation of steel products by water vehicles and trucks has received attention unwarranted by its true importance, and significant factors in the situation have been overlooked. The practical availability of each of these mediums of transportation is circumscribed by many inherent limitations. The producer located so as to be able to transport some products by water has an advantage over other producers not so located, which he is properly entitled to realize by a higher mill net return. His advantage often lies merely in the ability to reach markets from which rail freight rates would bar him. Where all the circumstances warrant it, the advantage is passed on to consumers by lower delivered prices. The producer's advantage, however, is one which may easily turn into a disadvantage. If he gives one consumer the benefit of the saving resulting from water transportation, he may soon have to make the same price to all consumers in the area and ship by rail, with freight disadvantages which will lower his mill net returns. Shipment by truck seldom involves an appreciable freight saving, and often involves additional freight cost. The added expense and inconvenience to the producer in truck shipments justify any additional charges made.

The proposed alternative to the basing point method is a uniform f. o. b. mill price system. The effects of this system would be extremely complex, and are therefore largely unforeseeable. Its exponents propose it in the name of abstract theory, and have outlined its characteristics and effects only with respect to the elimination of supposed evils of the basing point method. They have never described the operation of the system nor analyzed its effects in relation to the economic facts of the steel industry.

The uniform f. o. b. mill price system is expected by its exponents to eliminate high cost, inefficient and supposedly uneconomically located mills and to break up concentration of production facilities, by forcing the erection of small mills in all parts of the country. Such results, even if they would be accomplished by the system, would conflict with basic economic factors, and necessarily increase present production and transportation costs.

The system is also expected to increase existing competition. This is to be accomplished by the extraordinary means of arbitrarily limiting the competition between mills not adjacent to each other to marginal territory. Each mill, or group of mills, would be restricted in distribution to a circumscribed area subject to only slight possible variations in size. Each customer would be confined to a single or a very few sources of supply. The capacities of mills would be limited to the consumption in the prescribed territories, and any existing additional capacity would have to be scrapped. Serious dislocations in the steel industry and in industries dependent upon it would be inevitable.

Under a uniform f. o. b. mill price system, local monopolies and high assembly and production costs would displace the present widespread competition and low costs.

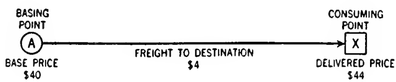
The following diagrams, prepared by United States Steel Corporation, are designed to clarify the operation of the basing point method of quoting delivered prices in the steel industry by means of a few simple illustrations of typical basic situations. While a good deal of mystery seems to have been made of the basing point practice, it is actually simple and easily understandable. These diagrams do not purport to give a complete picture of the price competition which exists in the sale of steel products. In particular, it must not be concluded that the prices of steel products at any consuming point are inflexibly determined by the application of the basing point practice—competition between different steel producers is keen and often results in delivered prices at the consuming point considerably lower than the delivered prices which would reuslt from the application of the basing point method as illustrated by these diagrams.

October 30, 1939.

THE BASING POINT METHOD

Most steel products are sold on a Delivered Price basis.

Diagram 1: How the Delivered Price is computed.



Base price is used herein in the sense of the announced price at the basing point, without freight or extras, and delivered price is used herein in the sense of the price at the consuming point, not including extras.

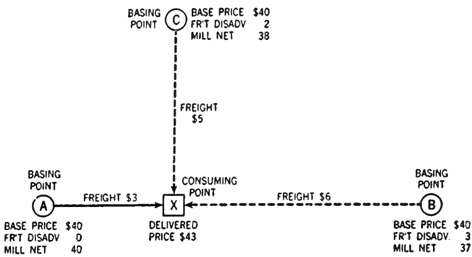
If the base price at a basing point is $40 per ton and freight therefrom to a consuming point is $4 per ton, the delivered price at such consuming point is $44 per ton.

Note. The base price of $40, used in this and subsequent diagrams, is purely arbitrary and is not to be taken as an actual price. Prices vary for different steel products.

THE BASING POINT METHOD

Diagram 2: Explanation of Freight Disadvantage and Freight Absorption.

Mill at A has lowest Base Price plus Freight to X.
Mills at B and C are at a Freight Disadvantage;
to sell at X they must absorb Freight.



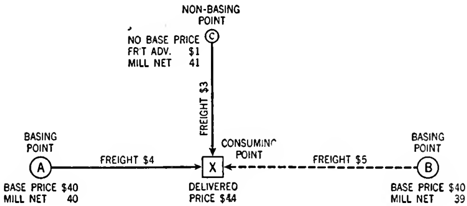
A, B and C are basing points, at each of which a base price of $40 per ton is announced by the mills located there. X is a consuming point. If the freight rate from each basing point to X were added to the base price at each basing point, three delivered prices would result, $43, $45 and $46 per ton, the delivered price from A being the lowest. However, a consumer at X naturally will not pay more than $43 per ton, the lowest delivered price quoted. Consequently, competition forces the mills at B and C also to quote a delivered price of $43 per ton at X, which results in their mill net returns being reduced to $37 and $38 per ton, respectively, which amounts are below their base prices.

Since such reduction below the base price is necessitated by the freight disadvantage of the mills at B and C, it is often called "freight absorption" by the critics of the basing point practice. The inference is that such mills are paying a higher freight rate than they charge to the customer. In reality, they are not charging any amount for freight, but are quoting such a delivered price as is necessary to meet the competition of the more favorably located mill at A, and paying the freight necessary to make deliverv at the consuming point

THE BASING POINT METHOD

Diagram 3: Explanation of first type of Freight Advantage and so-called "Phantom Freight"

Mill at (A) has lowest Base Price plus Freight to [X].
Mill at (C) charges the same Delivered Price. Having a Freight Advantage of $1 over (A), (C) realizes a Mill Net $1 higher than (A). This $1 is so-called "Phantom Freight".



A and B are basing points, at each of which a base price of $40 per ton is announced by the mills located there. c is not a basing point because the mill at c sees fit not to announce base prices at c, but merely meets the competitive delivered prices of other mills. The mill at c at any time in its discretion may decide to make c a basing point. At consuming point X, the lowest delivered price from a basing point mill is $44 per ton, computed upon $40 base price plus $4 freight from A. If the mill at B sells at X, it is at a freight disadvantage of $1 per ton and, accordingly, its mill net return will be $1 per ton less than its base price.

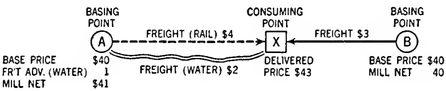
The non-basing point mill at c, however, has a freight advantage of $1 per ton over the mill at A in selling at X. By meeting the competitive delivered price of A at X, the mill at c receives a mill net return of $41, or $1 more than the mill at A which may explain why it has not decided to become a basing point. This amount has been characterized by critics of the basing point practice as "phantom freight", the inference being that the mill at c charges the customer a higher freight rate than it pays. In reality, the mill at c merely names a delivered price at X which permits it to realize the benefit of its freight advantage due to superior geographical location. It would realize this same advantage if it announced a base price at c of $41 per ton.

Since there are today very few non-basing point mills, very little freight advantage of this type is now realized in the steel industry.

THE BASING POINT METHOD

Diagram 4: Explanation of second type of Freight Advantage and so-called "Phantom Freight".

Mill at (B) has lowest Base Price plus Rail Freight to [X]
Mill at (A) charges the same Delivered Price.
When mill at (A) ships by water it has a Freight Advantage of $1 and realizes a Mill Net $1 above its Base Price.
This $1 is so-called "Phantom Freight".



Note: When mill at (A) ships by rail it is at a Freight Disadvantage of $1 and realizes a Mill Net $1 below its Base Price.

A and B are basing points, at each of which a base price of $40 per ton is announced by the mills located there. X is a consuming point, at which the lowest delivered price, using rail freight rates, is $43 per ton. If the mill at A sells at X, and ships by rail, it is at a freight disadvantage of $1 per ton. If it meets the delivered price of B at X and ships by rail, it will realize $1 per ton less than its base price.

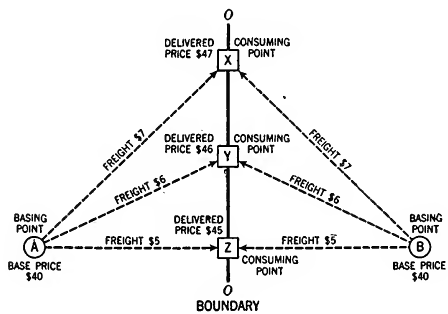
If the mill at A ships by water to X, it has a freight advantage of $1 per ton. If it meets the delivered price of B at X and ships by water, the mill at A realizes the benefit of its water freight advantage and obtains a mill net return $1 per ton higher than its base price. This advantage, when thus realized, is also characterized by critics of the basing point method as "phantom freight".

In reality, steel mills realize very little freight advantage or "phantom freight" of this type.

THE BASING POINT METHOD

Diagram 5: Determination of Boundary between Natural Market Territories

The Boundary dividing the Natural Market Territories of mills at Basing Points Ⓐ and Ⓑ is the line *O-O* connecting the points at which the Delivered Prices from Ⓐ and Ⓑ are equal.



A and B are basing points, at each of which a base price of $40 per ton is announced by the mills located there. X, Y and Z are consuming points, each of which is equi-distant freightwise from A and B. The line *O-O* connecting these points is the boundary between the natural market territories of the mills at A and B. As thus defined, natural market territory refers to the area in which a mill can sell at the competitive delivered price without realizing less than its base price. In sales at X, Y and Z and at points on its side of the line *O-O*, either the mill at A or the mill at B realizes a mill net return equal to its base price.

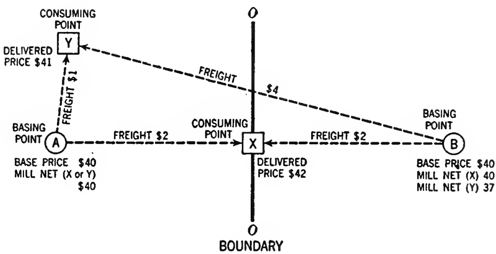
THE BASING POINT METHOD

Diagram 6: How shipping beyond Boundary of Natural Market Territory reduces Mill Net.

When mill at (B) sells to [X], its Mill Net is $40.

When mill at (B) sells to [Y], its Mill Net is only $37 because:

1. Freight is $2 higher.
2. Delivered Price is $1 lower.



A and B are basing points, at each of which a base price of $40 per ton is announced by the mills located there. At consuming point X, located on the boundary *O-O* between the natural market territories of the mills at A and B, the delivered price is $42 per ton, calculated with reference to the freight rate from either basing point. At consuming point Y, the delivered price is $41 per ton, equivalent to the base price at A of $40 per ton, plus $1 freight from A to Y.

When the mill at B sells at X, its mill net return equals its base price, but when it sells at Y, its mill net return is reduced by the effect of two factors. First, the delivered price is $1 per ton less than at X. Second, the freight rate from B to Y is $4 per ton, or $2 more than from B to X. Thus, the mill net return of the mill at B is reduced $3 per ton below its base price.

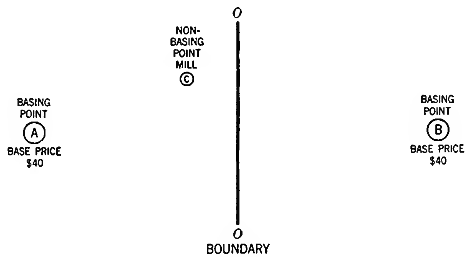
It may be advisable for the mill at B to sell at Y and realize a mill net return $3 per ton below its base price in order to obtain a higher operating rate and thus secure a lower average unit production cost.

THE BASING POINT METHOD

Diagram 7: Non-basing Point Mill.

Mills at Basing Points (A) and (B) realize full Base Prices on sales in their respective Natural Market Territories.

Non-basing Point mill at (C) has no Base Price and meets the Delivered Prices of (A) and (B) when it sells in their respective Natural Market Territories.



A and B are basing points, at each of which a base price of $40 per ton is announced by the mills located there. c is not a basing point, because the mill at c sees fit not to announce base prices at c, but merely meets the competitive delivered prices of other mills. The line *O-O* is the boundary of the natural market territories of the mills at A and B. Since the mill at c announces no base price at c, with which its mill net returns may be compared, it has no natural market territory in the sense in which that term is used in these diagrams. Either the mill at A or the mill at B can sell at points nearer c than A or B, respectively, without reducing its mill net return below its base price, as long as the mill at c follows its practice of meeting competitive delivered prices of other mills.

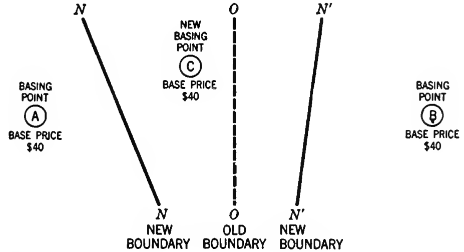
THE BASING POINT METHOD

Diagram 8: Effect of naming new Basing Point

After (C) becomes a Basing Point, the Boundary OO between (A) and (B) ceases to be significant.

Mill at (C) then has a Natural Market Territory, bounded by NN and $N'N'$, in which it establishes lower Delivered Prices than (A) or (B)

To sell in this territory, mills at Basing Points (A) and (B) must now absorb freight.



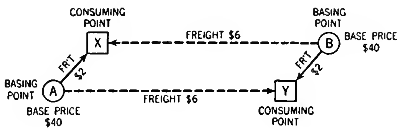
When the mill at C decides to announce a base price at C and C thus becomes a basing point, the line *N-N* becomes the boundary between the natural market territories of the mills at A and C and the line *N'-N'* becomes the boundary between the natural market territories of the mills at B and C. The line *O-O*, which marked the former boundary between the natural market territories of the mills at A and B, now ceases to be significant, because the mill net returns of the mills at A and B are reduced on sales to any point between *N-N* and *N'-N'*, respectively, regardless of whether or not such point is beyond the line *O-O*. The natural market territory of the mill at C has been carved out of the former natural market territories of the mills at A and B.

THE BASING POINT METHOD

Diagram 9: Illustration of Cross-hauling.

Products shipped from (A) to [Y] go past products shipped from (B) to [X]
This involves Cross-hauling only if:

1. The products shipped are identical.
2. Shipments occur at substantially the same time



A and B are basing points, at each of which a base price of $40 per ton is announced by the mills located there. X and Y are consuming points, at each of which the lowest delivered price calculated with reference to the nearest basing point, is $42 per ton. When the mill at A sells at Y or when the mill at B sells at X, in either case meeting the competitive delivered price at the consuming point, the mill net return is reduced $4 per ton below the base price. When the mill at A ships to Y and the mill at B ships to X, the shipments cross each other, in a broad sense, and this is said by critics of the basing point practice to constitute "cross-hauling". This is a very controversial term. Under a proper interpretation of the word, there is no cross-hauling unless the products shipped from A to Y and from B to X are identical and unless the shipments occur at substantially the same time. "Cross hauling" is the necessary result of competition in the steel industry.

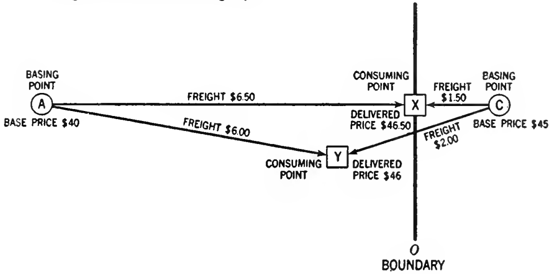
THE BASING POINT METHOD

Diagram 10: Effect of Basing Point price differential (Supplementary to Diagram 3).

In selling at $\boxed{X}$ or any point up to the Boundary *O-O* of its Market Territory, mill at Ⓒ realizes its higher Base Price and freight added equals freight paid.

In selling at $\boxed{Y}$, mill at Ⓒ realizes less than its Base Price, although:

1. It realizes more than mill at Ⓐ.
2. Freight added exceeds freight paid.



A is a basing point, at which a base price of $40 per ton is announced by the mill located there. C is a new basing point at which a base price of $45 per ton has recently been announced by the mill located there. X and Y are consuming points at which delivered prices of $46.50 and $46 per ton, respectively, are quoted.

Before C became a basing point, the mill at C merely met the delivered price of $46.50 quoted at X by the basing point mill at A, and realized a mill net return of $45 per ton, which was $5 more than that of the mill at A. This amount is characterized by critics of the basing point method as "phantom freight." When C becomes a basing point, with the announcement of a base price of $45 per ton by the mill at C, the price at X is unchanged, since the combination of base price at C plus freight from C to X equals the delivered price computed with reference to A. The mill at C still realizes a mill net return of $45 per ton, which is $5 higher than that of the mill at A. This amount can no longer be characterized as "phantom freight."

Likewise, before C became a basing point, the mill at C merely met the delivered price of $46 quoted at Y by the mill at A, and received a mill net return of $44 per ton, which was $4 more than that of the mill at A. When C becomes a basing point, with a base price of $45 per ton, the lowest delivered price at Y is still the base price at A plus freight from A to Y. The mill at C still receives a mill net return of $44 per ton, or $4 more than that of the mill at A. Although the mill net return of the mill at C is now $1 lower than its base price, it may still be charged with collecting "phantom freight," since the freight paid (C to Y) is less than the freight used (A to Y) in computing the delivered price at Y.

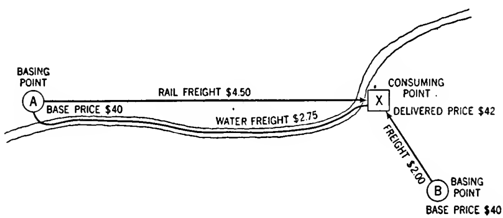
Actually, the higher mill net returns realized by the mill at C, both before and after C is named a basing point, represent the proper realization by the mill at C of its superior geographical location with respect to sales at X and Y. The mill at C may need such higher returns to meet higher raw material assembly or production costs.

THE BASING POINT METHOD

Diagram 11: Freight Disadvantage reduced by Water Shipment (Supplementary to Diagram 4).

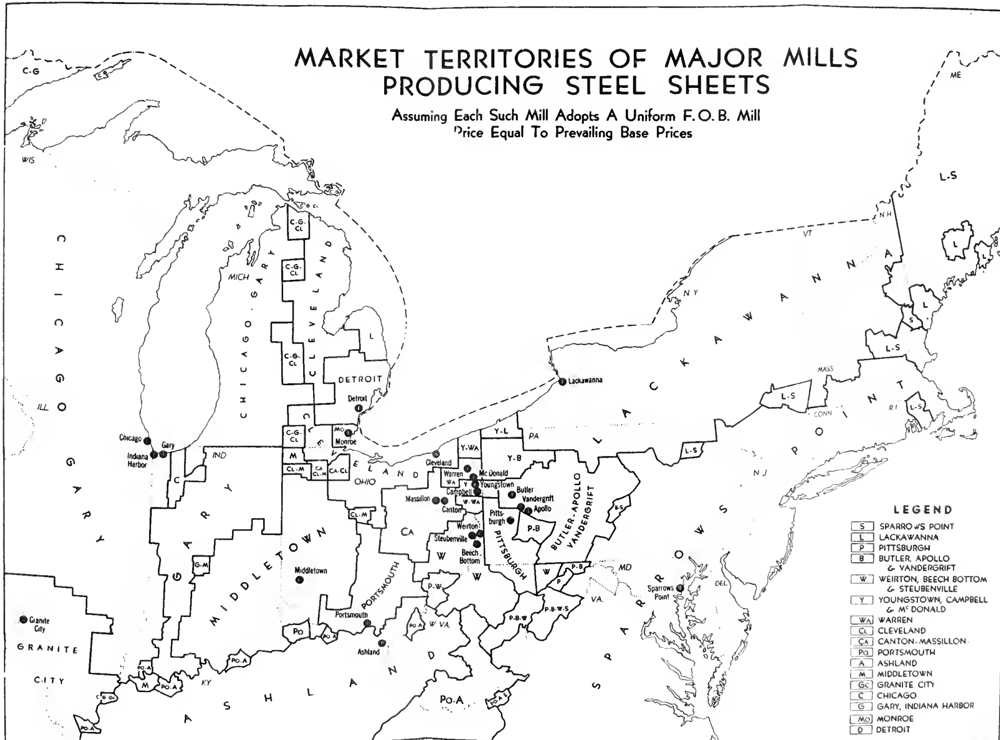
Mill at (A) has $2.50 Freight Disadvantage when shipping to $\boxed{X}$ by rail, and Mill Net is reduced $2.50

Mill at (A) has only $.75 Freight Disadvantage when shipping to $\boxed{X}$ by water, and Mill Net is reduced only $.75

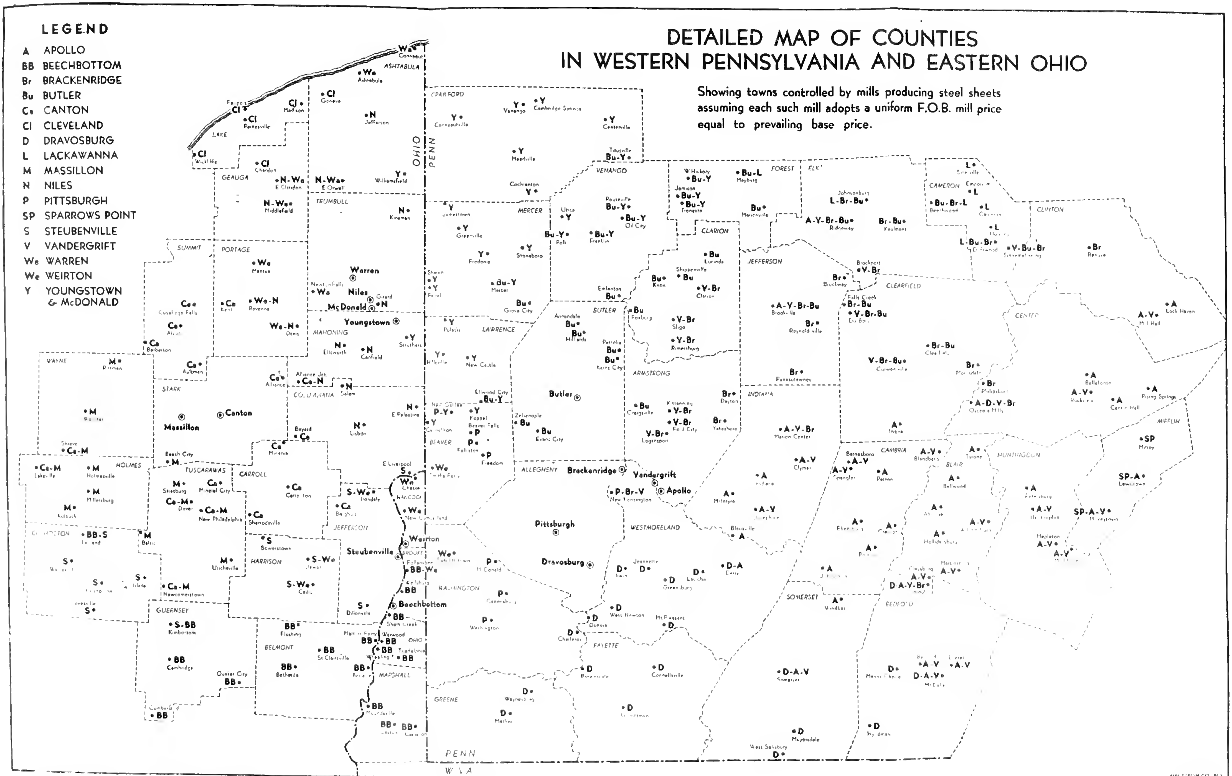


A and B are basing points, at each of which a base price of $40 per ton is announced by the mills located there. X is a consuming point at which the lowest delivered price is $42 per ton, calculated with reference to the freight rate from B. If the mill at A sells at X, and ships by rail, it is at a freight disadvantage of $2.50 per ton, and realizes $2.50 per ton less than its base price. If the mill at A ships by water to X, it is still at a freight disadvantage of $.75 per ton and realizes $.75 per ton less than its base price.

The advantage of the water shipment merely reduces the freight disadvantage of the mill at A from $2.50 per ton on rail shipments to $.75 per ton, when shipped by water.



MARKET TERRITORIES OF MAJOR MILLS PRODUCING STEEL SHEETS
Assuming Each Such Mill Adopts A Uniform F.O.B. Mill Price Equal To Prevailing Base Prices
LEGEND
S SPARROWS POINT
L LACKAWANNA
P PITTSBURGH
B BUTLER, APOLLO & VANDERGRIFT
W WEIRTON, BEECH BOTTOM & STEUBENVILLE
Y YOUNGSTOWN, CAMPBELL & McDONALD
WA WARREN
CL CLEVELAND
CA CANTON-MASSILLON
PO PORTSMOUTH
A ASHLAND
M MIDDLETOWN
GC GRANITE CITY
C CHICAGO
G GARY, INDIANA HARBOR
MO MONROE
D DETROIT


DETAILED MAP OF COUNTIES
IN WESTERN PENNSYLVANIA AND EASTERN OHIO
Showing towns controlled by mills producing steel sheets assuming each such mill adopts a uniform F.O.B. mill price equal to prevailing base price.
LEGEND
A APOLLO
BB BEECHBOTTOM
Br BRACKENRIDGE
Bu BUTLER
Ca CANTON
Cl CLEVELAND
D DRAVOSBURG
L LACKAWANNA
M MASSILLON
N NILES
P PITTSBURGH
SP SPARROWS POINT
S STEUBENVILLE
V VANDERGRIFT
Wa WARREN
We WEIRTON
Y YOUNGSTOWN & McDONALD
OHIO
PENN
PENN
W. VA.
Warren
Niles
McDonald
Youngstown
Canton
Massillon
Butler
Brackenridge
Vandergrift
Apollo
Pittsburgh
Dravosburg
Weirton
Steubenville
Beechbottom

Some Effects of Proposed Uniform F. O. B. Mill Price System

A uniform f. o. b. mill price system would require each mill to name a price at the mill applicable to all sales. The combination of mill price and transportation charges from mill to destination would determine the delivered cost of steel to the consumer. Generally, the delivered cost at any destination would vary as between different producing mills, and the consumer naturally would buy from the mill offering the lowest delivered cost, i. e., the mill having the lowest combination of mill price and freight from mill to the particular destination. A mill could sell only in the area in which the combination of its mill price and freight from mill to destination would be the lowest.

MAP NO. 1—MARKET TERRITORIES OF MAJOR MILLS PRODUCING STEEL SHEETS

Map No. 1 illustrates some immediate consequences of the introduction of the proposed system. Seventeen major sheet producing points are shown, with selling territories to which mills at such points would be restricted in the sale of sheets under the proposed system, assuming present freight rates and mill prices equal to present base prices at nearest basing points. (This results in equal mill prices at all mills, except at Detroit and Granite City, where the mill price is $2 higher, and at Monroe, where the mill price is $3 higher.) On this map, territories are determined by counties according to freight rates to one or two key towns, and mills adjacent to each other are considered as a single producing point.

Local monopolies are the rule; competitive areas the exception. All important sheet markets are in the monopoly area of a single producing point, or a producing point group such as Chicago-Gary. Sheet consumption is slight in areas of competition.

Size of monopoly areas depends generally upon the proximity of other mills. Sparrows Point and Lackawanna together have monopolies of all North Atlantic seaboard markets. Chicago-Gary has a monopoly of Wisconsin, Northern Illinois, Northern Indiana, and Western Michigan. In contrast, Western Pennsylvania and Eastern Ohio mills, having large capacities, are restricted to small areas.

Territorial allocation is extremely arbitrary. Warren and Youngstown mills, for example, each have monopolies in their home counties; they share territories to the north of Warren, but Warren, passing Youngstown, reaches territory south of Youngstown, which Youngstown cannot reach. Chicago-Gary mills share most territory which either can reach, including the home county of each; but Chicago, passing Gary, has a monopoly in certain Indiana counties; and Gary, after passing exclusive Chicago territory, has a monopoly in many other Indiana counties.

Note.—This map necessarily pictures the situation at a single relative price level. Differences in relative price levels would change market territories of mills, but would not eliminate the pattern of local monopoly and fixed territories here shown.

A mill in close proximity to other mills would tend to swallow up their entire market areas in seeking to widen its own market area by lowering its mill price.

At any relative level of their prices, two mills could generally compete in only one important market, since automatically the price of the first would exclude the second, or the price of the second would exclude the first, from every other such market.

MAP NO. 2—DETAILED MAP OF COUNTIES IN WESTERN PENNSYLVANIA AND EASTERN OHIO

Map No. 2 shows miscroscopically a section of the area shown on Map No. 1, and further illustrates in detail some immediate consequences of the introduction of a uniform f. o. b. mill price system. On Map No. 1, selling territories are determined by county. On Map No. 2, each town is separately marked with the symbol of the mill or mills which could sell in such towns under the proposed system, assuming mill prices equal to present base prices at nearest basing points, and present freight rates. The closer scrutiny thus afforded indicates that the problem is more complex than Map No. 1 shows.

Local monopolies are even more striking on Map No. 2. In many areas shown on Map No. 1 as enjoying competition from more than one producing point, there are actually only a few towns where competition occurs. Many towns are accessible to only one mill. For example, Columbiana County, Ohio, is shown on Map No. 1 as an area of competition between Warren mills (including Niles) and Weirton-Beechbottom-Steubenville mills. Actually, as shown on Map No. 2, three towns are accessible to Niles only, one town to Steubenville only, and

one town to Canton only. Similarly, Westmoreland County, Pennsylvania, is shown on Map No. 1 as an area of competition between the Pittsburgh group of mills and the Butler-Vandergrift-Apollo mills. Actually, as Map No. 2 indicates, the Dravosburg mill has a monopoly in six towns, and the Vandergrift mill in another, while Dravosburg and Apollo compete in one town, and Pittsburgh, Brackenridge, and Vandergrift compete in another.

Mills located close to each other are shown as groups on Map No. 1, and thus competition between them throughout the group territory is indicated on such map. The separate detailed consideration of each mill and each town on Map No. 2 shows local monopolies and arbitrary restrictions of selling points even in such territories. For example, Cambria County, Pennsylvania, is in the joint territory of Butler-Vandergrift-Apollo on Map No. 1. Actually, as shown on Map No. 2, Apollo has a monopoly in five towns, while Apollo and Vandergrift compete in three others. In Weirton-Beechbottom-Steubenville territory: Beechbottom has a monopoly of all towns in Belmont County, Ohio; in Jefferson County, Ohio, Steubenville a monopoly in two towns, and Canton in another, while Steubenville and Weirton compete in one town.

NOTE.—While this map is necessarily based on a single relative level of prices at different mills, it is not believed that the pattern shown on the map would greatly change at any possible relative level. Prices at adjacent mills would be identical, since each would be obliged to meet another's price reductions immediately, or lose its entire selling territory.

Composite mill net yield and cost per weighted ton shipped, U. S. Steel Corporation and subsidiaries

[1926=100]

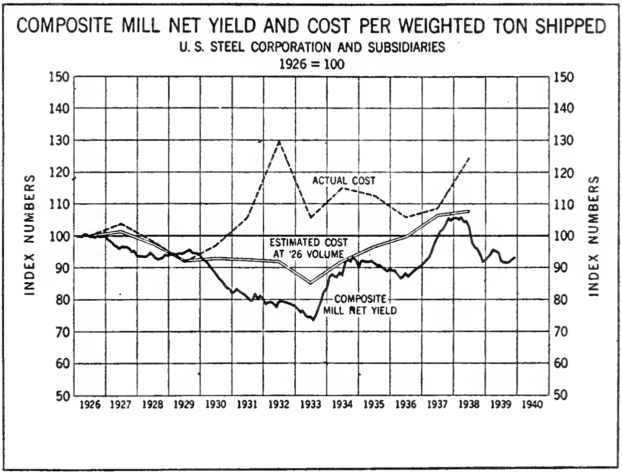
Year	Composite Mill Net Yield												Year
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1926	99.8	100.0	99.6	100.2	100.1	99.8	99.8	99.5	99.9	99.6	99.9	99.8	1926
1927	98.7	98.0	97.0	96.6	95.9	96.4	96.3	96.3	95.9	94.9	95.2	93.5	1927
1928	93.4	93.4	93.3	93.4	94.3	93.8	92.9	92.4	92.7	92.9	93.9	93.7	1928
1929	94.2	94.2	93.9	94.3	94.2	94.3	95.0	95.4	94.5	94.3	94.3	94.0	1929
1930	92.4	91.6	91.2	89.9	88.9	88.0	86.6	86.0	85.0	83.7	83.3	82.0	1930
1931	82.2	83.2	82.3	81.8	81.4	80.4	79.9	79.8	81.9	80.0	81.3	80.2	1931
1932	78.6	79.1	79.3	78.7	77.7	79.2	79.5	79.3	79.0	78.8	78.2	77.9	1932
1933	77.0	76.0	76.6	75.0	74.5	74.6	73.5	75.0	77.2	79.4	82.6	83.5	1933
1934	87.1	88.1	87.4	87.1	88.5	87.4	91.8	92.9	91.9	93.3	92.5	89.9	1934
1935	92.1	92.0	91.9	91.9	92.0	91.2	90.5	90.8	90.0	89.6	88.8	89.6	1935
1936	89.0	89.1	87.6	86.4	87.1	88.2	87.3	88.1	88.8	89.6	90.0	90.6	1936
1937	91.4	92.3	93.3	95.8	98.0	99.8	101.6	101.9	103.4	105.7	104.8	105.3	1937
1938	105.4	105.1	105.9	104.3	104.4	102.7	97.9	96.2	95.9	93.7	91.6	92.2	1938
1939	93.2	94.1	95.8	95.1	94.8	92.1	91.4	91.4	91.4	92.2	93.0		

The composite mill net yield index represents the amount, relative to that for 1926, received per ton by U. S. Steel Corporation subsidiaries (after freight) from sales of a representative constant assortment of all principal products.

Year	Cost per Weighted Ton Shipped		Year	Cost per Weighted Ton Shipped	
	Actual Cost	Estimated Cost at 1926 Volume		Actual Cost	Estimated Cost at 1926 Volume
1926	100.0	100.0	1933	105.8	85.1
1927	103.6	101.1	1934	115.0	92.0
1928	98.3	97.2	1935	112.7	96.6
1929	91.8	92.0	1936	105.9	99.6
1930	96.9	92.8	1937	108.7	106.3
1931	105.6	92.2	1938	124.5	107.6
1932	129.6	91.7			

Actual cost per weighted ton shipped is total cost, exclusive of bond interest, Federal income taxes, miscellaneous non-operating income and expense, and of inter-company items, for all subsidiaries of U. S. Steel Corporation, divided by the number of weighted tons shipped. Weighted tonnages are actual tonnages, adjusted for change in proportions of high and low cost products and for the equivalent tonnage of average cost rolled and finished steel products represented by products other than steel. The cost of operations not related to the production of steel is included in total cost, but since such cost is a small percentage of the total and since the other operations tend to expand and contract with the volume of steel production, the relative change in the total cost per weighted ton many be considered fairly indicative of the change in the cost of producing steel.

Estimated cost if 1926 volume maintained is the actual cost per weighted ton shipped adjusted to 1926 volume on the assumption that the percentage change in the average cost per ton as the rseult of a given change in volume would have been the same in each of the respective years as it is estimated to have been under 1938 conditions.



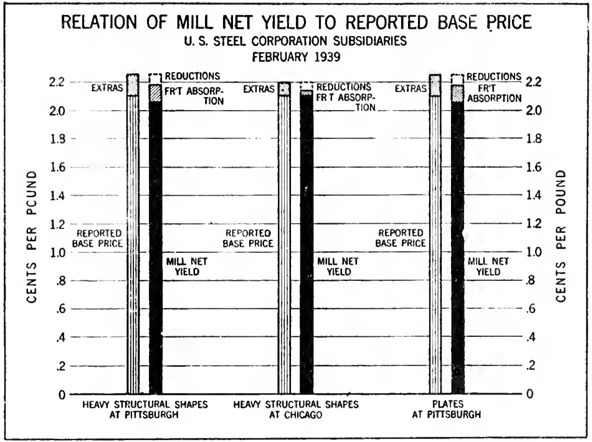
The composite mill net yield index, which is indicative of the level of steel prices, has generally been lower than the index of actual costs per ton since 1926. This is true even if the effect on costs of changes in the operating rate is eliminated, as shown by the index of the estimated costs per ton if 1926 volume had obtained throughout the period. In the base year 1926, with the various subsidiaries operating at an average rate of 89%, U. S. Steel Corporation realized 6.2% on its investment.

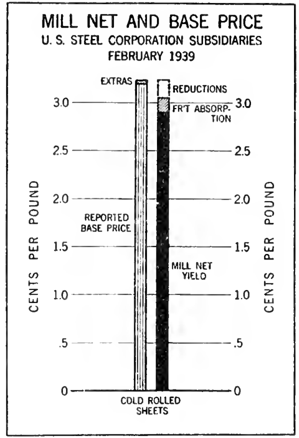
Relation of mill net yield to reported base price, U. S. Steel Corporation Subsidies, February 1939

Item	Cents per Pound			
	H'y Structural Shapes (at Pittsburgh)	H'y Structural Shapes (at Chicago)	Plates (at Pittsburgh)	Cold Rolled Sheets
Reported Base Price	2.100	2.100	2.100	3,200
Extras	.145	.099	.154	.041
Total	2.245	2.199	2.254	3.241
Mill Net Yield (Incl. Extras)	2.062	2.106	2.061	2.908
Freight Absorption	.122	.035	.119	.145
Total	2.184	2.141	2.180	3.053
Price Reductions	.061	.058	.074	.188
Reported Base Price	2.100	2.100	2.100	3.200
Mill Net Yield (Incl. Extras)	2.062	2.106	2.061	2.908
Difference	.038	*.006	.039	.292

*Mill net yield is in excess of reported base price.

Reported base prices are as reported by Iron Age.
Other data are from U. S. Steel Corporation subsidiaries' reports to T. N. E. C. in answer to Questionnaire Form B, entitled "Distribution and Pricing of Selected Steel Products."
Data on heavy structural shapes and plates at Pittsburgh and Chicago are for shipments from Homestead and South Chicago plants, respectively. Data on cold rolled sheets are for shipments from Irvin and Gary plants.
Freight absorption is adjusted for basing point price differentials.





The difference between the reported base price (plus extras) and the mill net yield (including extras) on any product consists of two elements: (1) freight absorption and (2) price reductions.

Data with respect to shipments of selected products from selected mills of U. S. Steel Corporation subsidiaries for the month of February 1939, taken from the answers to a T. N. E. C. questionnaire show the average amount of reductions made in the base prices.

In the case of heavy structural shapes shipped from Chicago and cold rolled sheets shipped from Pittsburgh and Chicago, the price reductions exceeded the amount of the freight absorption, while the price reductions were less than the freight absorption on the shipments of heavy structural shapes and plates from Pittsburgh.

Average delivered price and freight absorption, February 1939 shipments of selected steel products—U. S. Steel Corporation subsidiaries

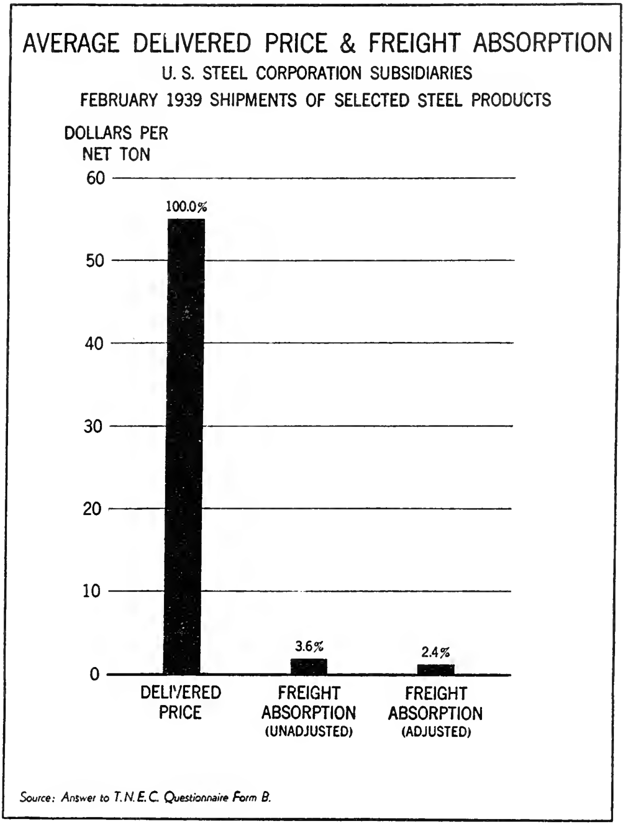
Item	Dollars per Net Ton	Per Cent of Delivered Price
Delivered Price (Incl. Extras)	55.00	100.0
Freight Absorption (Unadjusted)	1.99	3.6
Freight Absorption (Adjusted)	1.33	2.4

Data are from U. S. Steel Corporation subsidiaries' reports to T. N. E. C., in answer to Questionnaire Form B, entitled "Distribution and Pricing of Selected Steel Products."

Delivered price is "Total Invoiced Delivered Value," as shown on Form B.

Unadjusted freight absorption is difference between "Actual Freight Paid or Allowed on Shipments from Mill to Destination" and "Freight Charges Added to Base Prices to Arrive at Invoiced Value," as shown on Form B.

Adjusted freight absorption (as defined in Department of Justice "Supplement to Form B Tables," discussion of Table 9) is such unadjusted freight absorption decreased by the amounts by which the basing point prices applicable on certain sales were greater than the base prices at other basing points.



The unadjusted freight absorption (i.e., the difference between "freight added" and "freight paid") per net ton on the domestic shipments of selected steel products from selected mills of U. S. Steel Corporation subsidiaries made during February 1939 averaged $1.99 a ton or 3.6% of the average delivered price of $55 per ton, including extras. The adjusted freight absorption (i.e., the unadjusted figure minus basing point price differentials) averaged $1.33 a ton or 2.4% of the average delivered price.

Average delivered price and freight absorption, February 1939 shipments of selected steel products—selected producing companies

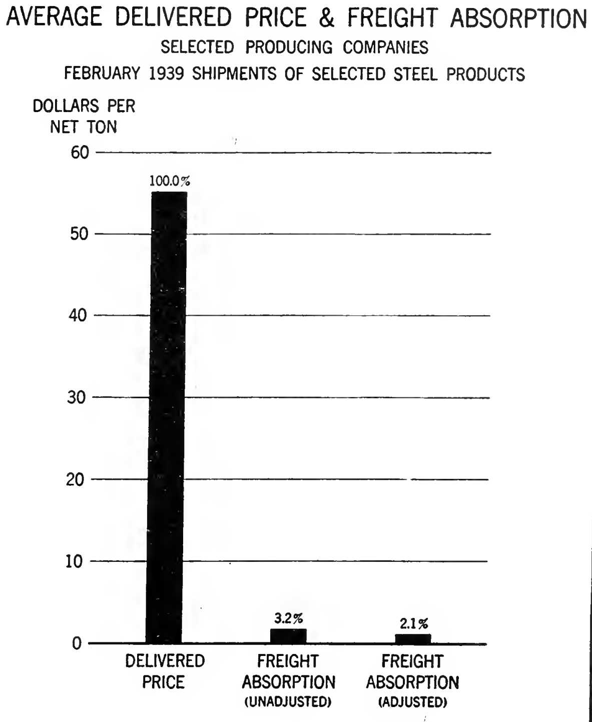
Item	Dollars per Net Ton	Per Cent of Delivered Price
Delivered Price (Incl. Extras)	55.06	100.0
Freight Absorption (Unadjusted)	1.77	3.2
Freight Absorption (Adjusted)	1.16	2.1

Data are from Department of Justice Summary compiled from T. N. E. C. Questionnaire Form B, entitled "Distribution and Pricing of Selected Steel Products."

Delivered price is "Total Invoice Delivered Value" as shown on Form B.

Unadjusted freight absorption is difference between "Actual Freight Paid or Allowed on Shipments from Mill to Destination" and "Freight Charges Added to Base Prices to Arrive at Invoiced Value," as shown on Form B.

Adjusted freight absorption (as defined in Department of Justice "Supplement to Form B Tables," discussion of Table 9) is such unadjusted freight absorption decreased by the amounts by which the basing point prices applicable on certain sales were greater than the base prices at other basing points.



Source: Department of Justice Summary Compiled from T. N. E. C. Questionnaire Form B.

The unadjusted freight absorption (i.e., the difference between "freight added" and "freight paid") per net ton on domestic shipments of selected steel products from selected mills of selected producing companies made during February 1939 averaged $1.77 a ton or 3.2% of the average delivered price of $55.06 per ton, including extras. The adjusted freight absorption (i.e., the unadjusted figure minus basing point price differentials) averaged $1.16 or 2.1% of the average delivered price.

Breakdown of average delivered price, February 1939 shipments of selected steel products—U. S. Steel Corporation subsidiaries

Item	Dollars per Net Ton	Per Cent of Delivered Price
Delivered Price (Including Extras)	55.00	100.0
Freight Paid	5.71	10.4
Mill Net Yield (Including Extras)	49.29	89.6
Freight Added	3.72	6.8
Freight Absorption (Unadjusted)	1.99	3.6
Basing Point Price Differentials	0.66	1.2
Freight Absorption (Adjusted)	1.33	2.4

Data are from U. S. Steel Corporation subsidiaries' report to T. N. E. C. in answer to Questionnaire Form B, entitled "Distribution and Pricing of Selected Steel Products."

Delivered price is "Total Invoiced Delivered Value" as shown on Form B.

Freight paid is the "Actual Freight Paid or Allowed on Shipments from Mill to Destination," as shown on Form B.

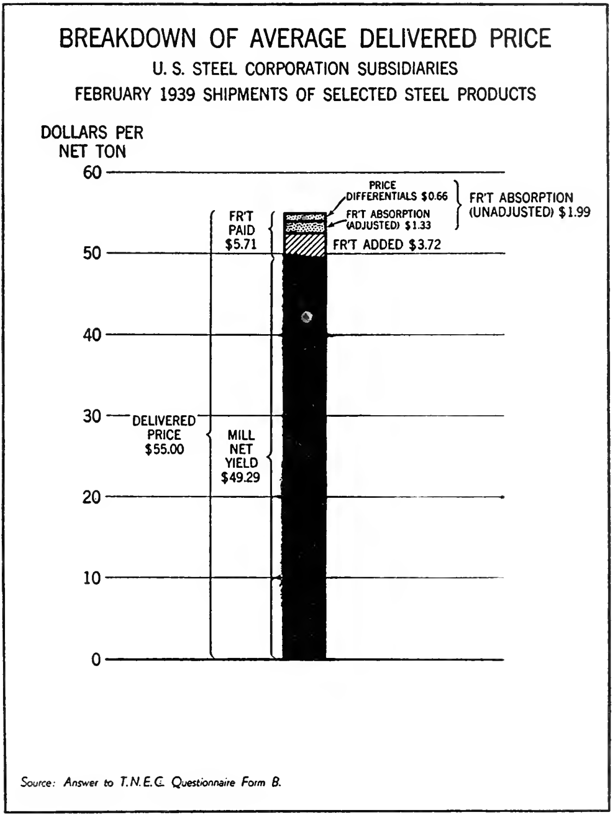
Mill net yield is delivered price less freight paid.

Freight added is "Freight Charges Added to Base Prices to Arrive at Invoiced Value," as shown on Form B.

Unadjusted freight absorption is difference between such freight paid and such freight added.

Basing point price differentials (as defined in Department of Justice "Supplement to Form B Tables," discussion of Table 9) are amounts by which basing point prices applicable on certain sales were greater than the base prices at other basing points.

Adjusted freight absorption (as defined in Department of Justice "Supplement to Form B Tables," discussion of Table 9) is difference between freight absorption (unadjusted) and such basing point price differentials.



The "Freight Charges Added to Base Prices to Arrive at Invoiced Value", as shown on Form B, on domestic shipments of selected steel products from selected mills of United States Steel Corporation subsidiaries made during February 1939, amounted to 6.8% of the delivered price, while the "Actual Freight Paid or Allowed on Shipments From Mill to Destination", as shown on Form B, amounted to 10.4%.

The unadjusted freight absorption amounted to 3.6% of the delivered price, and the adjusted freight absorption, after deduction of the amount of basing point price differentials, amounted to 2.4% of the delivered price.

Breakdown of average delivered price, February 1939 shipments of selected steel products—selected producing companies

Item	Dollars per Net Ton	Per Cent of Delivered Price
Delivered Price (Including Extras)	55.06	100.0
Freight Paid	4.77	8.6
Mill Net Yield (Including Extras)	50.29	91.4
Freight Added	3.00	5.4
Freight Absorption (Unadjusted)	1.77	3.2
Basing Point Price Differentials	.61	1.1
Freight Absorption (Adjusted)	1.16	2.1

Data are from Department of Justice Summary compiled from T. N. E. C. Questionnaire Form B, entitled "Distribution and Pricing of Selected Steel Products."

Delivered price is "Total Invoiced Delivered Value" as shown on Form B.

Freight paid is the "Actual Freight Paid or Allowed on Shipments from Mill to Destination," as shown on Form B.

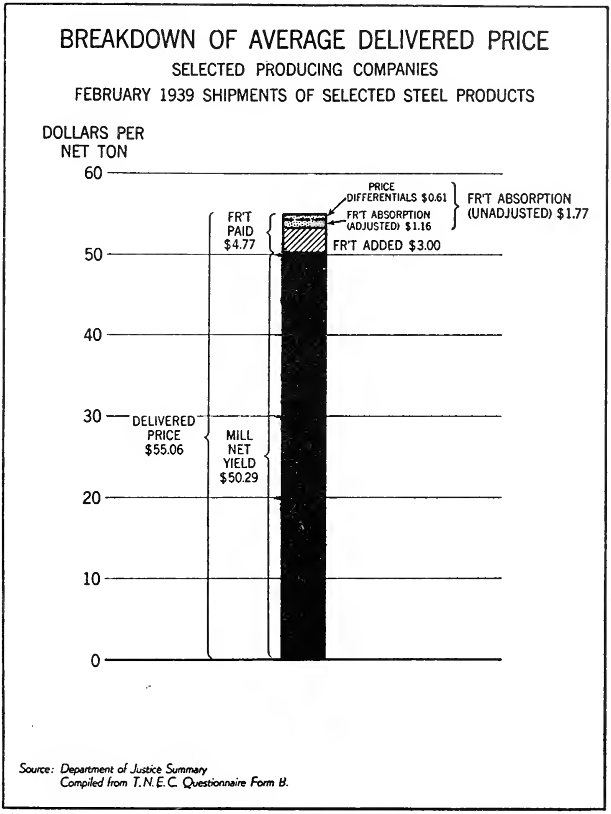
Mill net yield is delivered price less freight paid.

Freight added is "Freight Charges Added to Base Prices to Arrive at Invoiced Value," as shown on Form B.

Unadjusted freight absorption is difference between such freight paid and such freight added.

Basing point price differentials (as defined in Department of Justice "Supplement to Form B Tables," discussion of Table 9) are amounts by which basing point prices applicable on certain sales were greater than the base prices at other basing points.

Adjusted freight absorption (as defined in Department of Justice "Supplement to Form B Tables," discussion of Table 9) is difference between freight absorption (unadjusted) and such basing point price differentials.



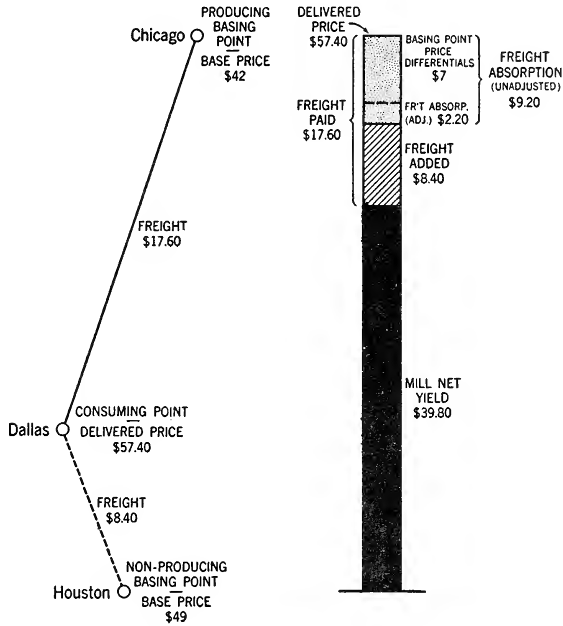
The "Freight Charges Added to Base Prices to Arrive at Invoiced Value", as shown on Form B, on domestic shipments of selected steel products from selected mills of selected producing companies made during February 1939, amounted to 5.4% of the delivered price, while the "Actual Freight Paid or Allowed on Shipments from Mill to Destination", as shown on Form B, amounted to 8.6%.

The unadjusted freight absorption amounted to 3.2% of the delivered price, and the adjusted freight absorption, after deduction of the amount of basing point price differentials, amounted to 2.1% of the delivered price.

Explanation of unadjusted and adjusted freight absorption

Item	Dollars per Net Ton	Item	Dollars per Net Ton
Freight Paid	17.60	Basing Point Price Differential	7.00
Freight Added	8.40		
Freight Absorption (Unadjusted)	9.20	Freight Absorption (Adjusted)	2.20
Basing Point Price (Houston)	49.00	Base Price at Producing Point	42.00
Basing Point Price (Chicago)	42.00	Freight Absorption (Adjusted)	2.20
		Mill Net Yield	39.80

EXPLANATION OF UNADJUSTED & ADJUSTED FREIGHT ABSORPTION



The unadjusted freight absorption is the difference between freight paid, $17.60, and freight added, $8.40, or $9.20. However, since the base price applicable on the sale includes a differential over the base price at the producing mill, the unadjusted freight absorption is partially offset by the amount of differential. The adjusted freight absorption is the difference between the unadjusted freight absorption of $9.20 and the differential of $7.00, or $2.20.

The mill net yield is reduced below the base price only by the amount of the adjusted freight absorption.

Section D—Capacity and Production

Total ingot capacity—U. S. Steel Corporation subsidiaries and other steel producing companies

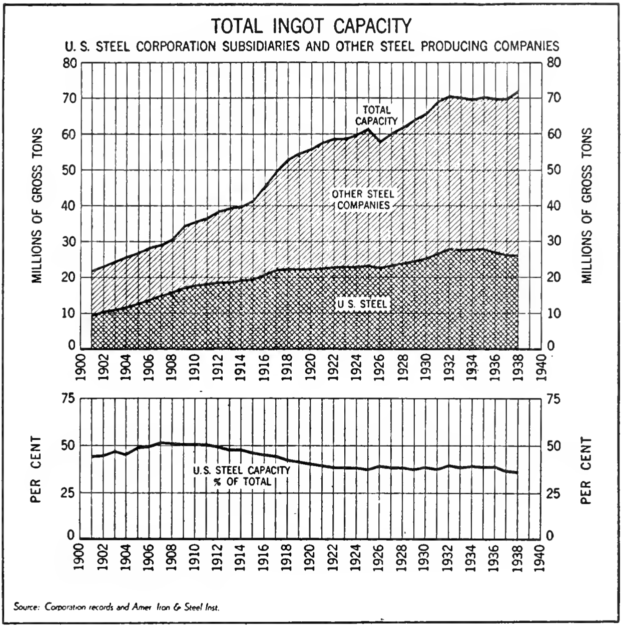
Year	Capacity in Thousands of Gross Tons			U. S. Steel in % of Total U. S.	Year	Capacity in Thousands of Gross Tons			U. S. Steel in % of Total U. S.
	U. S. Steel	Other Companies	Total U. S.			U. S. Steel	Other Companies	Total U. S.	
1901	[1] 9,431	[1] 12,032	21,463	43.9	1920	22,353	33,284	55,637	40.2
1902	[1] 10,033	[1] 12,667	[1] 22,700	44.2	1921	22,694	34,683	57,377	39.6
1903	[1] 11,211	[1] 12,689	[1] 23,900	46.9	1922	22,694	35,723	58,417	38.8
1904	[1] 11,548	[1] 13,642	25,190	45.8	1923	22,802	35,843	58,645	38.9
1905	[1] 12,882	[1] 13,418	[1] 26,300	49.0	1924	22,816	36,616	59,432	38.4
1906	[1] 13,445	[1] 13,955	[1] 27,400	49.1	1925	23,125	38,012	61,137	37.8
1907	14,777	[1] 13,723	[1] 28,500	51.8	1926	22,749	35,064	57,813	39.3
1908	15,590	[1] 14,710	[1] 30,300	51.5	1927	23,177	36,855	60,032	38.6
1909	17,157	[1] 16,843	[1] 34,000	50.5	1928	23,762	37,703	61,465	38.7
1910	17,845	[1] 17,355	[1] 35,200	50.7	1929	24,202	39,582	63,784	37.9
1911	18,083	[1] 17,917	[1] 36,000	50.2	1930	25,163	40,003	65,166	38.6
1912	18,822	[1] 19,178	[1] 38,000	49.5	1931	26,075	42,905	68,980	37.8
1913	18,496	[1] 20,504	[1] 39,000	47.4	1932	27,841	42,499	70,340	39.6
1914	18,998	20,691	39,689	47.9	1933	27,342	42,849	70,191	39.0
1915	19,228	22,066	41,294	46.6	1934	27,342	[2] 42,413	[2] 69,755	39.2
1916	20,841	24,947	45,788	45.5	1935	27,342	42,704	70,046	39.0
1917	22,046	27,568	49,614	44.4	1936	26,657	43,133	69,790	38.2
1918	22,207	30,334	52,541	42.3	1937	25,772	44,003	69,775	36.9
1919	22,340	32,143	54,483	41.0	1938	25,790	45,804	71,594	36.0

Source: Corporation records and American Iron and Steel Institute. Data as of January 1st each year.

[1] Partly estimated.

[2] Figures for 1934 and subsequent years include only that portion of capacity of steel for castings used by foundries operated by companies producing steel ingots.

Tennessee Coal, Iron and Railroad Company data included in Corporation figures beginning with January 1, 1908.



Ingot capacity of the steel industry increased steadily until 1932 (the decrease in the total curve in 1926 was due to a readjustment of capacity data by the American Iron and Steel Institute, rather than to an abandonment of facilities to produce steel). Since 1932 the capacity of the country has remained practically unchanged, as a result of the reduced demand for steel, particularly from the railroad and construction industries.

U. S. Steel Corporation's portion of the total capacity of the country has decreased from a high of 52% in 1908 to 36% in 1938.

Steel ingot capacity compared with population—U. S. Steel Corporation subsidiaries and total United States

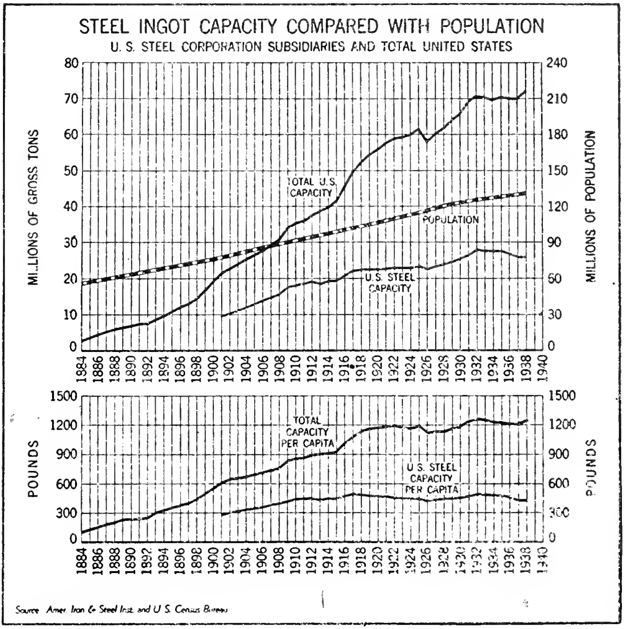
Year	Capacity—Thous. Gross Tons		Population Total U. S. (Thousands)	Capacity Per Capita—Pounds	
	U. S. Steel	Total U. S.		U. S. S.	U. S.
1884		2,821	55,379		114
1885		[1] 3,675	56,658		145
1886		4,529	57,938		175
1887		5,270	59,217		199
1888		[1] 5,866	60,496		217
1889		6,461	61,775		234
1890		[1] 6,803	63,056		242
1891		[1] 7,145	64,361		249
1892		7,487	65,666		255
1893		[1] 8,607	66,970		288
1894		9,726	68,275		319
1895		[1] 10,864	69,580		350
1896		12,002	70,885		379
1897		[1] 13,086	72,189		406
1898		14,169	73,494		432
1899		[1] 16,535	74,799		495
1900		[1] 18,900	76,129		556
1901	[1] 9,431	21,463	77,747	272	618
1902	[1] 10,033	[1] 22,700	79,365	283	641
1903	[1] 11,211	[1] 23,900	80,983	310	661
1904	[1] 11,548	25,190	82,601	313	683
1905	[1] 12,882	[1] 26,300	84,219	343	700
1906	[1] 13,445	[1] 27,400	85,837	351	715
1907	14,777	[1] 28,500	87,455	378	730
1908	15,590	[1] 30,300	89,073	392	762
1909	17,157	[1] 34,000	90,691	424	840
1910	17,845	[1] 35,200	92,267	433	855
1911	18,083	[1] 36,000	93,682	432	861
1912	18,822	[1] 38,000	95,097	443	895
1913	18,496	[1] 39,000	96,512	429	905
1914	18,998	39,689	97,928	435	908
1915	19,228	41,294	99,343	434	931
1916	20,841	45,788	100,758	463	1,018
1917	22,046	49,614	102,173	483	1,088
1918	22,207	52,541	103,588	480	1,136
1919	22,340	54,483	105,003	476	1,162
1920	22,353	55,637	106,543	470	1,170
1921	22,694	57,377	108,208	470	1,188
1922	22,694	58,417	109,873	463	1,191
1923	22,802	58,645	111,537	458	1,178
1924	22,816	59,432	113,202	451	1,176
1925	23,125	61,137	114,867	450	1,192
1926	22,749	57,813	116,532	437	1,111
1927	23,177	60,032	118,197	439	1,138
1928	23,762	61,465	119,862	444	1,149
1929	24,202	63,784	121,526	446	1,176
1930	25,163	65,166	123,091	458	1,186
1931	26,075	68,980	124,113	471	1,245
1932	27,841	70,340	124,974	499	1,261
1933	27,342	70,191	125,770	487	1,250
1934	27,342	[2] 69,755	126,626	483	1,234
1935	27,342	70,046	127,521	480	1,230
1936	26,657	69,790	128,429	465	1,217
1937	25,772	69,775	129,257	447	1,209
1938	25,790	71,594	130,085	444	1,233

Source: American Iron and Steel Institute, U. S. Census Bureau and Corporation records.

[1] Partly estimated

[2] Figures for 1934 and subsequent years include only that portion of capacity of steel for castings used by foundries operated by companies producing steel ingots.

Capacity data are as of January 1 of each year; population data are as of July 1 of each year.



The increase in ingot capacity of U. S. Steel Corporation since 1901 has roughly kept pace with the growth in population of the United States. Ingot capacity of the total steel industry, however, has increased more rapidly than population.

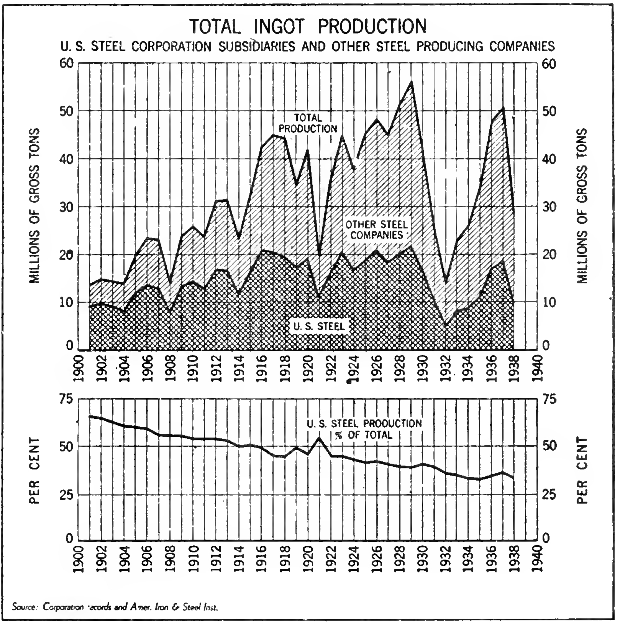
Total ingot production—U. S. Steel Corporation subsidiaries and other steel producing companies

Year	Production in Thousands of Gross Tons			U. S. Steel in % of Total U. S.	Year	Production in Thousands of Gross Tons			U. S. Steel in % of Total U. S
	U. S. Steel	Other Companies	Total U. S.			U. S. Steel	Other Companies	Total U. S.	
1901	8,855	4,618	13,473	65.7	1920	19,278	22,855	42,133	45.8
1902	9,760	5,197	14,947	65.2	1921	10,966	8,818	19,784	55.4
1903	9,174	5,361	14,535	63.1	1922	16,082	19,521	35,603	45.2
1904	8,413	5,447	13,360	60.7	1923	20,330	24,614	44,944	45.2
1905	12,006	8,018	20,024	60.0	1924	16,479	21,453	37,932	43.4
1906	13,529	9,869	23,398	57.8	1925	18,899	26,495	45,394	41.6
1907	13,100	10,263	23,363	56.1	1926	20,307	27,987	48,294	42.0
1908	7,839	6,184	14,023	55.9	1927	18,486	26,449	44,935	41.2
1909	13,355	10,600	23,905	55.8	1928	20,106	31,438	51,544	39.0
1910	14,179	11,916	26,095	54.3	1929	21,869	34,564	56,433	38.8
1911	12,753	10,923	23,676	53.9	1930	16,726	23,973	40,699	41.1
1912	16,901	14,350	31,251	54.1	1931	10,082	15,863	25,946	38.9
1913	16,656	14,645	31,301	53.2	1932	4,929	8,752	13,681	36.0
1914	11,826	11,687	23,513	50.3	1933	8,047	15,185	23,232	34.6
1915	16,376	15,775	32,151	50.9	1934	8,660	[1] 17,375	[1] 26,055	33.2
1916	20,911	21,863	42,774	48.9	1935	11,131	22,962	34,093	32.6
1917	20,285	24,776	45,061	45.0	1936	16,908	30,860	47,768	35.4
1918	19,583	24,879	44,462	44.0	1937	18,532	32,036	50,569	36.6
1919	17,200	17,471	34,671	49.6	1938	9,397	18,953	28,350	33.1

Source: Corporation records and American Iron and Steel Institute. Data include production of castings.

[1] Figures for 1934 and subsequent years include only that portion of production of steel for castings used by foundries operated by companies producing steel ingots.

Tennessee Coal, Iron and Railroad Company data included in Corporation figures beginning with January 1, 1908.



Ingot production has shown great variation from year to year, because the demand for steel products fluctuates so widely with changes in general business conditions.

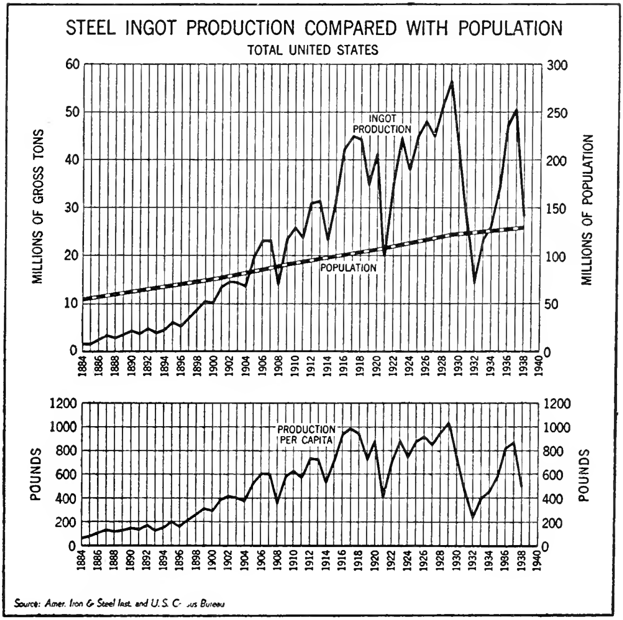
The portion of the country's ingots produced by U. S. Steel Corporation has been declining with few interruptions since 1901. Whereas the Corporation produce ' 66% of the total in 1901, it produced but 33% in 1938.

Steel ingot production compared with population—total United States

Year	Ingot Production (Thousands of Gross Tons)	Population (Thousands)	Production per Capita (Pounds)	Year	Ingot Production (Thousands of Gross Tons)	Population (Thousands)	Production per Capita (Pounds)
1884	1,551	55,379	63	1912	31,251	95,097	737
1885	1,712	56,658	67	1913	31,301	96,512	726
1886	2,563	57,938	99	1914	23,513	97,928	538
1887	3,339	59,217	126	1915	32,151	99,343	726
1888	2,899	60,496	107	1916	42,774	100,758	952
1889	3,386	61,775	123	1917	45,061	102,173	988
1890	4,277	63,056	152	1918	44,462	103,588	961
1891	3,904	64,361	136	1919	34,671	105,003	739
1892	4,928	65,666	168	1920	42,133	106,543	885
1893	4,020	66,970	134	1921	19,784	108,208	410
1894	4,412	68,275	145	1922	35,603	109,873	726
1895	6,115	69,580	197	1923	44,944	111,537	903
1896	5,282	70,885	167	1924	37,932	113,202	750
1897	7,157	72,189	222	1925	45,394	114,867	885
1898	8,933	73,494	272	1926	48,294	116,532	927
1899	10,640	74,799	319	1927	44,935	118,197	851
1900	10,188	76,129	300	1928	51,544	119,862	963
1901	13,474	77,747	388	1929	56,433	121,526	1,039
1902	14,947	79,365	421	1930	40,699	123,091	741
1903	14,535	80,983	401	1931	25,946	124,113	468
1904	13,860	82,601	376	1932	13,681	124,974	244
1905	20,024	84,219	533	1933	23,232	125,770	414
1906	23,398	85,837	612	1934	[1] 26,055	126,626	461
1907	23,363	87,455	598	1935	34,093	127,521	599
1908	14,023	89,073	352	1936	47,768	128,429	833
1909	23,955	90,691	591	1937	50,569	129,257	876
1910	26,095	92,267	634	1938	28,350	130,085	488
1911	23,676	93,682	567				

Source: American Iron and Steel Institute and U. S. Census Bureau.
Ingot production data include production of castings. Population data are as of July 1 of each year.

[1] Figures for 1934 and subsequent years include only that portion of production of steel for castings used by foundries operated by companies producing steel ingots.



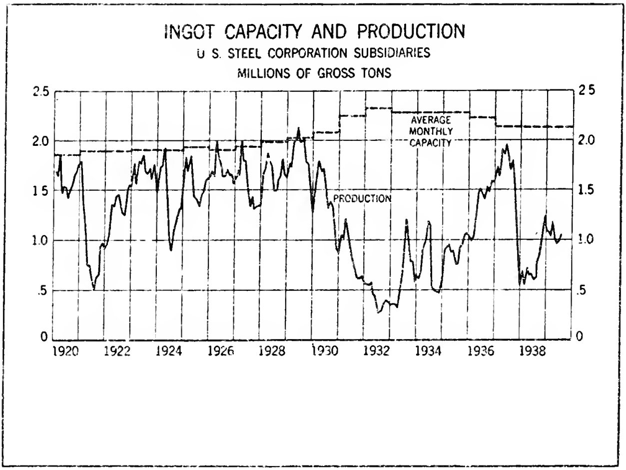
From 1884 through 1929, steel ingot production in this country expanded more rapidly than population and production per capita increased from 63 to 1,039 pounds. Since 1929, the situation has been reversed; the peak in 1937 was lower than that of 1929 and in 1938 production was only 488 pounds per capita.

Ingot capacity and production—U. S. Steel Corporation subsidiaries

[Monthly Production and Average Monthly Capacity in Thousands of Gross Tons]

	1920	1923	1926	1929	1932	1935	1938
Jan	1,676	1,780	1,701	1,753	551	909	685
Feb	1,630	1,560	1,634	1,733	549	933	548
Mar	1,858	1,809	1,996	1,975	569	957	711
Apr	1,468	1,755	1,812	2,019	457	879	642
May	1,548	1,865	1,721	2,142	432	899	647
Jun	1,522	1,694	1,637	1,970	342	753	587
Jul	1,415	1,660	1,631	1,982	263	758	612
Aug	1,500	1,738	1,711	2,009	291	923	764
Sep	1,559	1,599	1,651	1,772	361	951	838
Oct	1,658	1,778	1,668	1,754	392	1,039	1,047
Nov	1,685	1,616	1,553	1,495	376	1,070	1,224
Dec	1,759	1,476	1,593	1,266	348	1,059	1,092
Aver. Cap'y	1,863	1,900	1,899	2,017	2,320	2,278	2,143
	1921	1924	1927	1930	1933	1936	1939
Jan	1,803	1,736	1,695	1,480	350	997	1,075
Feb	1,349	1,738	1,649	1,652	349	1,037	1,037
Mar	1,103	1,934	1,993	1,792	305	1,215	1,177
Apr	750	1,529	1,780	1,690	466	1,472	1,018
May	743	1,206	1,781	1,719	655	1,515	963
Jun	612	1,015	1,492	1,489	926	1,473	988
Jul	501	876	1,328	1,283	1,204	1,409	1,047
Aug	622	1,120	1,446	1,382	1,000	1,534	....
Sep	648	1,227	1,311	1,340	790	1,490	....
Oct	939	1,316	1,335	1,140	785	1,590	....
Nov	978	1,317	1,339	905	569	1,578	....
Dec	919	1,466	1,339	854	648	1,598	....
Aver. Cap'y	1,891	1,901	1,931	2,073	2,278	2,221	2,143
	1922	1925	1928	1931	1934	1937	
Jan	962	1,832	1,657	1,042	602	1,738	....
Feb	1,048	1,674	1,715	1,013	693	1,639	....
Mar	1,359	1,859	1,882	1,241	917	1,901	....
Apr	1,346	1,578	1,792	1,134	976	1,855	....
May	1,446	1,440	1,731	997	1,194	1,964	....
Jun	1,456	1,401	1,498	837	1,152	1,865	....
Jul	1,359	1,348	1,497	743	536	1,695	....
Aug	1,279	1,461	1,606	661	516	1,790	....
Sep	1,246	1,472	1,633	597	487	1,603	....
Oct	1,493	1,599	1,821	608	461	1,131	....
Nov	1,553	1,613	1,659	642	508	800	....
Dec	1,534	1,623	1,616	567	618	552	....
Aver. Cap'y	1,891	1,927	1,980	2,240	2,278	2,148	....

Data include ingots and castings.



At four distinct periods in the interval 1920-1929, demands upon ingot production facilities exceeded U. S. Steel Corporation's capacity. About 1929 the Corporation inaugurated a program of plant modernization which was accompanied by an increase in ingot capacity. Having been commenced, this program was carried on during the years 1930-1932 in spite of the business depression, the magnitude and duration of which could not be foreseen.

Since 1932, some obsolete capacity has been retired. At present, the ingot capacity of the Corporation is no more than sufficient to provide the steel which is required at periods of peak demand.

Ingot capacity and production—total United States

[Monthly Production and Average Monthly Capacity in Thousands of Gross Tons]

	1920	1923	1926	1929	1932	1935	1938
Jan	3. 624	3, 841	4, 132	4, 545	1, 500	2, 915	1, 764
Feb	3, 402	3, 472	3, 785	4, 372	1, 496	2, 817	1, 726
Mar	3, 917	4, 067	4, 469	5, 118	1, 448	2, 910	2, 038
Apr	3, 132	3, 964	4, 106	4, 999	1, 273	2, 682	1, 951
May	3, 423	4, 216	3, 928	5, 339	1, 137	2, 675	1, 831
Jun	3, 539	3, 767	3, 734	4, 951	923	2, 294	1, 660
Jul	3, 328	3, 531	3, 635	4, 898	815	2, 303	2, 008
Aug	3, 562	3, 696	3, 987	4, 988	856	2, 962	2, 580
Sep	3, 561	3, 357	3, 913	4, 573	1, 003	2, 869	2, 692
Oct	3, 581	3, 5[illegible]7	4, 074	4, 579	1, 099	3, 192	3, 158
Nov	3, 133	3, 134	3, 076	3, 556	1, 043	3, 200	3, 618
Dec	2, 779	2, 863	3, 467	2, 932	871	3, 121	3, 185
Aver. cap'y	4, 636	4, 887	4, 818	5, 315	5, 862	5, 837	5, 966
	1921	1924	1927	1930	1933	1936	1939
Jan	2, 517	3, 650	3, 823	3, 808	1, 030	3, 086	3, 225
Feb	1, 999	3, 826	3, 845	4, 067	1, 087	3, 002	3, 037
Mar	1, 795	4, 207	4, 575	4, 288	910	3, 384	3, 459
Apr	1, 387	3, 348	4, 163	4, 142	1, 361	3, 991	3, 021
May	1, 446	2, 640	4, 083	4, 014	2, 005	4, 097	2, 970
Jun	1, 146	2, 066	3, 526	3, 445	2, 599	4, 035	3, 175
Jul	918	1, 878	3, 232	2, 945	3, 210	3, 975	3, 214
Aug	1, 300	2, 553	3, 529	3, 085	2, 905	4, 247	3, 823
Sep	1, 342	2, 828	3, 298	2, 863	2, 313	4, 214	4, 299
Oct	1, 847	3, 125	3, 345	2, 714	2, 112	4, 601	5, 480
Nov	1, 897	3, 121	3, 155	2, 230	1, 540	4, 389	5, 551
Dec	1, 630	3, 569	3, 203	1, 995	1, 822	4, 491	5, 246
Aver. Cap'y	4, 781	4, 953	5, 003	5, 431	5, 849	5, 816	6, 088
	1922	1925	1928	1931	1934	1937	
Jan	1, 893	4, 193	4, 028	2, 534	2, 025	4, 786	
Feb	2, 071	3, 752	4, 081	2, 570	2, 243	4, 498	
Mar	2, 814	4, 194	4, 549	3, 083	2, 836	5, 303	
Apr	2, 902	3, 584	4, 345	2, 794	2, 976	5, 155	
May	3, 219	3, 455	4, 246	2, 574	3, 447	5, 237	
Jun	3, 128	3, 205	3, 778	2, 149	3, 102	4, 254	
Jul	2, 953	3, 084	3, 841	1, 907	1, 509	4, 631	
Aug	2, 629	3, 421	4, 217	1, 733	1, 399	4, 958	
Sep	2, 818	3, 490	4, 186	1, 560	1, 286	4, 362	
Oct	3, 410	3, 889	4, 693	1, 605	1, 502	3, 449	
Nov	3, 430	3, 903	4, 306	1, 607	1, 633	2, 189	
Dec	3, 301	3, 971	4, 055	1, 313	1, 991	1, 496	
Aver. Cap'y	4, 868	5, 095	5, 122	5, 748	5, 813	5, 815	

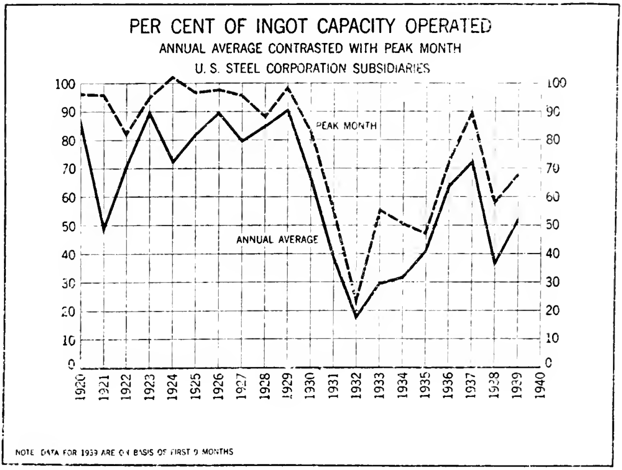
Data include production of open-hearth, Bessemer, crucible and electric ingots, but exclude production of castings. Portion of the 1939 monthly data represented by production of crucible and electric ingots was estimated.

Percent of ingot capacity operated—U. S. Steel Corporation subsidiaries

Year	Average Rate for Year	Peak Month	Average Rate—Peak Month
1920	86.2	March	96.0
1921	48.3	January	95.7
1922	70.9	November	82.0
1923	89.2	May	94.8
1924	72.2	March	102.2
1925	81.7	March	96.8
1926	89.3	March	97.5
1927	79.8	March	95.5
1928	84.7	March	88.0
1929	90.4	May	98.3
1930	66.5	March	82.9
1931	38.7	March	54.9
1932	17.7	March	22.7
1933	29.4	July	55.1
1934	31.6	May	50.4
1935	40.8	November	47.0
1936	63.4	December	72.0
1937	72.0	May	89.7
1938	36.4	November	57.7
1939 [1]	51.9	September	67.6

Per cent of ingot capacity operated is based on ingots and castings.
Peak month rate is calculated from actual monthly capacity.

[1] First 9 months.



In the steel business it is imperative that there be sufficient capacity to meet peak demands. Customers' orders vary as to size and quality to such an extent that steel must be rolled to order and cannot ordinarily be taken from stock. Some steel products, such as sheets which are to be subjected to deep-drawing as in the manufacture of automobile fenders, must be used in a comparatively short time after production in order to obtain the best results.

The extent to which the curve representing peak monthly operations is above the curve representing average operations is an indication of the extent to which the capacity needed to meet peak demands even in years of low production is in excess of the average capacity operated. It is apparent that the entire amount of the capacity of the United States Steel Corporation subsidiaries is needed to meet peak demands in prosperous years.

Steel production and manufacturing production—Federal Reserve indexes adjusted for seasonal variation

[1923–1925=100]

	Steel	Mfrg		Steel	Mfrg		Steel	Mfrg
	1923			1928			1933	
Jan	102	99	Jan	112	107	Jan	29	63
Feb	102	100	Feb	112	110	Feb	31	61
Mar	104	103	Mar	111	109	Mar	22	56
Apr	111	106	Apr	119	109	Apr	35	65
May	118	106	May	113	108	May	48	77
Jun	117	105	Jun	113	109	Jun	71	93
Jul	115	103	Jul	123	110	Jul	99	102
Aug	112	101	Aug	120	111	Aug	80	91
Sep	101	101	Sep	126	114	Sep	65	83
Oct	98	98	Oct	123	116	Oct	60	76
Nov	90	97	Nov	127	118	Nov	47	70
Dec	90	97	Dec	127	120	Dec	60	73
	1924			1929			1934	
Jan	97	99	Jan	126	120	Jan	56	76
Feb	105	101	Feb	128	119	Feb	64	80
Mar	108	100	Mar	130	120	Mar	67	82
Apr	92	95	Apr	131	122	Apr	77	85
May	74	88	May	139	123	May	85	86
Jun	66	84	Jun	148	127	Jun	86	83
Jul	60	83	Jul	149	125	Jul	48	74
Aug	79	89	Aug	139	121	Aug	39	72
Sep	85	93	Sep	136	121	Sep	38	69
Oct	86	95	Oct	126	119	Oct	41	72
Nov	93	97	Nov	108	110	Nov	49	74
Dec	107	102	Dec	95	101	Dec	65	85
	1925			1930			1935	
Jan	111	105	Jan	107	105	Jan	80	90
Feb	108	105	Feb	118	107	Feb	80	88
Mar	108	104	Mar	109	104	Mar	72	87
Apr	98	103	Apr	107	104	Apr	67	86
May	99	102	May	104	101	May	66	84
Jun	99	102	Jun	102	97	Jun	66	85
Jul	98	103	Jul	91	92	Jul	69	87
Aug	105	102	Aug	90	89	Aug	81	89
Sep	105	103	Sep	83	89	Sep	83	92
Oct	107	106	Oct	76	86	Oct	88	95
Nov	116	109	Nov	71	85	Nov	96	97
Dec	118	112	Dec	63	82	Dec	103	101
	1926			1931			1936	
Jan	114	109	Jan	70	82	Jan	86	96
Feb	109	107	Feb	73	86	Feb	83	92
Mar	111	106	Mar	75	87	Mar	83	93
Apr	112	106	Apr	70	87	Apr	100	100
May	112	106	May	66	86	May	105	101
Jun	114	108	Jun	60	82	Jun	112	105
Jul	115	108	Jul	58	82	Jul	119	109
Aug	119	110	Aug	50	78	Aug	120	110
Sep	118	111	Sep	45	75	Sep	119	110
Oct	117	111	Oct	45	71	Oct	127	111
Nov	109	108	Nov	51	71	Nov	137	115
Dec	105	105	Dec	42	73	Dec	143	121
	1927			1932			1937	
Jan	107	106	Jan	44	71	Jan	139	115
Feb	111	107	Feb	42	68	Feb	129	116
Mar	112	108	Mar	35	64	Mar	126	117
Apr	111	108	Apr	32	61	Apr	130	118
May	113	110	May	29	59	May	134	118
Jun	106	108	Jun	26	58	Jun	119	114
Jul	104	107	Jul	25	57	Jul	140	114
Aug	101	106	Aug	23	59	Aug	142	117
Sep	98	104	Sep	28	65	Sep	125	110
Oct	95	102	Oct	31	66	Oct	100	101
Nov	94	101	Nov	31	63	Nov	68	85
Dec	97	102	Dec	28	64	Dec	49	79

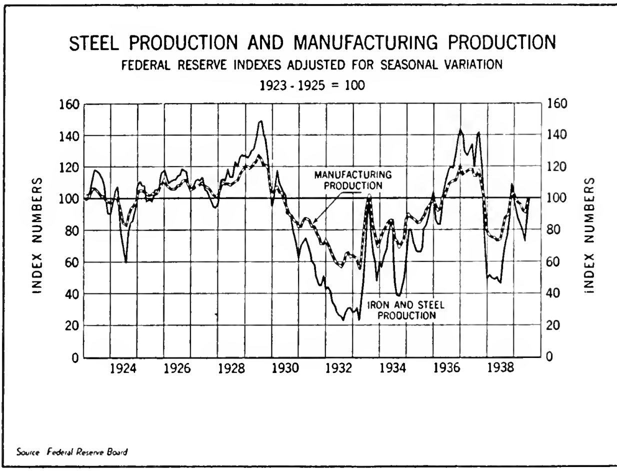
Steel production and manufacturing production—Federal Reserve indexes adjusted for seasonal variation—Continued

[1923-1925=100]

	Steel	Mfrg		Steel	Mfrg		Steel	Mfrg
	1938			1938			1939	
Jan	52	76	Jul	62	82	Jan	94	100
Feb	50	75	Aug	70	87	Feb	87	97
Mar	49	75	Sep	75	89	Mar	83	96
Apr	50	73	Oct	90	95	Apr	79	92
May	47	73	Nov	108	103	May	73	91
Jun	46	74	Dec	101	104	Jun	89	97
						Jul	100	[1] 101

Source: Federal Reserve Board.

[1] Preliminary.



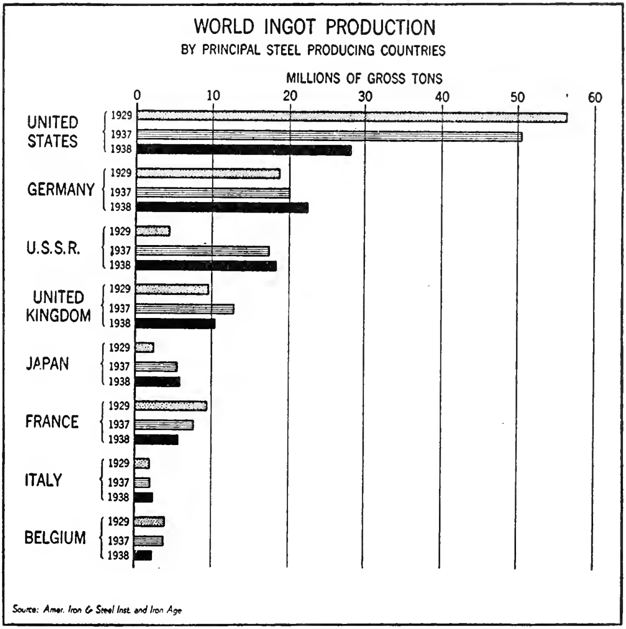
The steel business in the United States is good when general business is good and vice versa. There is marked correlation in the fluctuations in steel production and those of all manufacturing production, although the peaks and valleys of steel production are somewhat more pronounced than those for all manufacturing.

World ingot production by principal steel producing countries

Country	Production in Thousands of Gross Tons 1929	1937	1938	Country	Production in Thousands of Gross Tons 1929	1937	1938
United States	56, 433	50, 569	28, 350	Japan	2, 258	5, 719	5, 860
Germany [1]	18, 786	20, 176	22, 876	France	9, 546	7, 795	6, 077
U. S. S. R.	4, 645	17, 544	18, 156	Italy	2, 089	2, 054	2, 285
United Kingdom	9, 636	12, 964	10, 394	Belgium	4, 015	3, 808	2, 249

[1] Includes Austria but not Czechoslovakia.

Source: American Iron and Steel Institute, except production of Japan, 1938, estimated by Iron Age (foreign figures based on information received from abroad).
Data include production of steel ingots and castings.

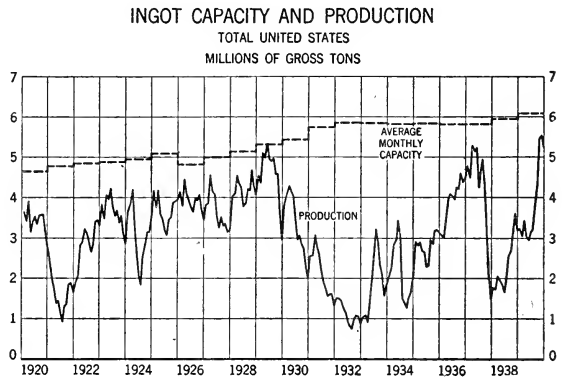


The United States produces more steel than any other country in the world. In the last ten years, however, its steel production has declined, while that of most of the other countries has increased, notably Germany and Russia.

Ingot capacity and production

[Total United States]

	Monthly Production and Average Monthly Capacity in Thousands of Gross Tons						
	1920	1923	1926	1929	1932	1935	1938
Jan	3, 624	3, 841	4, 132	4, 545	1, 500	2, 915	1, 764
Feb	3, 402	3, 472	3, 785	4, 372	1, 496	2, 817	1, 726
Mar	3, 917	4, 067	4, 469	5, 118	1, 448	2, 910	2, 038
Apr	3, 132	3. 964	4, 106	4, 999	1, 273	2 682	1, 951
May	3, 423	4, 216	3, 928	5, 339	1, 137	2, 675	1, 831
Jun	3, 539	3, 767	3, 734	4, 951	923	2, 294	1, 660
Jul	3, 328	3, 531	3, 635	4, 898	815	2, 303	2. 008
Aug	3, 562	3, 696	3, 987	4, 988	856	2, 962	2, 580
Sep	3, 561	3, 357	3, 913	4, 573	1, 003	2, 869	2, 692
Oct	3, 681	3, 577	4, 074	4, 579	1, 099	3, 192	3, 158
Nov	3, 133	3, 134	3, 076	3, 556	1, 043	3, 200	3, 618
Dec	2, 779	2, 863	3, 467	2, 932	871	3, 121	3, 185
Aver. Cap'y	4, 636	4, 887	4, 818	5, 315	5, 862	5, 837	5, 966
	1921	1924	1927	1930	1933	1936	1939
Jan	2, 517	3, 650	3, 823	3, 808	1, 030	3, 086	3, 225
Feb	1, 999	3, 826	3, 845	4, 067	1, 087	3, 002	3, 037
Mar	1, 795	4, 207	4. 575	4, 288	910	3, 384	3, 459
Apr	1, 387	3, 348	4, 163	4, 142	1, 361	3, 991	3, 021
May	1, 446	2, 640	4, 083	4, 014	2, 005	4, 097	2, 970
Jun	1, 146	2, 066	3, 526	3, 445	2, 599	4, 035	3, 175
Jul	918	1, 878	3, 232	2, 945	3, 210	3, 975	30, 214
Aug	1, 300	2, 553	3, 529	3, 085	2, 905	4, 247	3, 823
Sep	1, 342	2, 828	3, 298	2, 863	2, 313	4, 214	4. 299
Oct	1, 847	3, 125	3, 345	2, 714	2, 112	4, 601	5, 480
Nov	1, 897	3, 121	3, 155	2, 230	1, 540	4, 389	5, 551
Dec	1, 630	3, 569	3, 203	1, 995	1, 822	4, 491	5, 246
Aver. Cap'y	4, 781	4, 953	5, 003	5, 431	5, 849	5, 816	6, 088
	1922	1925	1928	1931	1934	1937	
Jan	1, 893	4, 193	4, 028	2, 534	2, 025	4, 786	
Feb	2, 071	3, 752	4. 081	2, 570	2, 243	4, 498	
Mar	2. 814	4, 194	4, 549	3, 083	2, 836	5. 303	
Apr	2, 902	3, 584	4, 345	2, 794	2, 976	5, 155	
May	3, 219	3, 455	4, 246	2, 574	3, 447	5, 237	
Jun	3, 128	3, 205	3, 778	2, 149	3, 102	4, 254	
Jul	2. 953	3, 084	3, 841	1, 907	1, 509	4, 631	
Aug	2, 629	3, 421	4, 217	1, 733	1, 399	4, 958	
Sep	2, 818	3, 490	4, 186	1, 560	1, 286	4, 362	
Oct	3, 410	3, 889	4. 693	1, 605	1, 502	3, 449	
Nov	3, 430	3, 903	4, 306	1, 607	1, 633	2, 189	
Dec	3, 301	3, 971	4, 055	1, 313	1, 991	1, 496	
Aver. Cap'y	4, 868	5, 095	5, 122	5, 748	5, 813	5, 815	



Source: American Iron & Steel Institute

Capacity of the steel industry is not excessive. Unused or idle capacity should not be confused with "excess" capacity. Ingot capacity, an accepted basis for determining rates of operations, reflects roughly operations of finishing capacities. Even in periods of peak demand; orders are not distributed among products in such a way as to make possible full utilization of all finishing facilities. In practice, therefore, operations probably would never be maintained at 100 per cent of either ingot or finishing capacity because of lack of coordination between demand and capacity for various products. Production might, therefore, be expected to run below capacity even at the peak of the cycle.

In times of emergency, or under the pressure of extraordinary demands on the industry, it might occasionally be possible to attain an operating rate slightly in excess of 100 per cent of rated capacity for short periods by bringing into operation obsolete facilities, lengthening the work week, eliminating holidays, or by other means.

SECTION E—LABOR

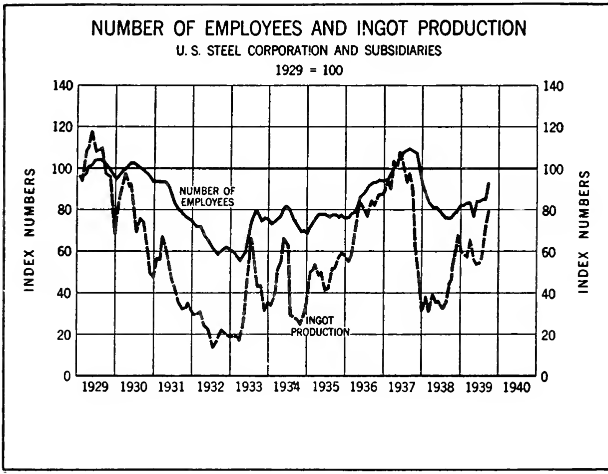
Number of employees and ingot production—U. S. Steel Corporation and subsidiaries

	(000 Omitted)		Index No.'s 1929=100	
	No. of Empl's	Ingot Prod'n (Gr. Tons)	Empl's	Prod'n
1929				
Jan	243	1,753	96	96
Feb	244	1,733	96	95
Mar	245	1,975	97	108
Apr	255	2,019	101	111
May	259	2,142	102	118
Jun	261	1,970	103	108
Jul	263	1,982	104	109
Aug	263	2,009	104	110
Sep	260	1,772	103	97
Oct	255	1,754	101	96
Nov	248	1,495	98	82
Dec	241	1,266	95	69
1930				
Jan	242	1,480	96	81
Feb	248	1,652	98	91
Mar	252	1,792	100	98
Apr	256	1,690	10[illegible]	93
May	261	1,719	103	94
Jun	262	1,489	103	81
Jul	259	1,283	102	70
Aug	256	1,382	101	76
Sep	253	1,340	100	74
Oct	248	1,140	98	62
Nov	244	905	96	49
Dec	238	854	94	47
1931				
Jan	238	1,042	94	57
Feb	237	1,013	94	56
Mar	237	1,241	94	68
Apr	237	1,134	94	62
May	233	997	92	54
Jun	221	837	87	46
Jul	207	743	82	41
Aug	203	661	80	36
Sep	199	597	79	33
Oct	194	608	77	33
Nov	192	642	76	35
Dec	189	567	75	31
1932				
Jan	186	551	73	30
Feb	182	549	72	30
Mar	182	569	72	31
Apr	173	457	68	25
May	167	432	66	24
Jun	159	342	63	19
Jul	155	263	61	14
Aug	150	291	59	16
Sep	152	361	60	20
Oct	154	392	61	22
Nov	158	376	62	20
Dec	154	348	61	19
1933				
Jan	151	350	60	19
Feb	147	349	58	19
Mar	140	305	55	17
Apr	144	466	57	26
May	151	655	60	36
Jun	171	926	67	51
Jul	190	1,204	75	66
Aug	201	1,000	79	55
Sep	201	790	79	43
Oct	190	785	75	43
Nov	192	569	76	31
Dec	189	648	75	36
1934				
Jan	185	602	73	33
Feb	187	693	74	38
Mar	190	917	75	50
Apr	195	976	77	54
May	204	1,194	81	66
Jun	208	1,152	82	63
Jul	203	536	80	29
Aug	192	516	76	28
Sep	186	487	73	27
Oct	178	461	70	25
Nov	176	508	70	28
Dec	174	618	69	34
1935				
Jan	182	909	72	50
Feb	191	933	75	51
Mar	195	957	77	53
Apr	196	879	78	48
May	197	899	78	49
Jun	197	753	78	41
Jul	196	758	77	42
Aug	197	923	78	51
Sep	197	951	78	52
Oct	193	1,039	77	57
Nov	198	1,070	78	59
Dec	196	1,059	77	58
1936				
Jan	196	997	77	55
Feb	197	1,037	78	57
Mar	201	1,215	79	67
Apr	211	1,472	83	81
May	220	1,515	87	83
Jun	223	1,473	88	81
Jul	229	1,409	91	77
Aug	235	1,534	93	84
Sep	238	1,490	94	82
Oct	239	1,590	94	87
Nov	240	1,578	95	87
Dec	239	1,598	94	88

Number of employees and ingot production—U. S. Steel Corporation and subsidiaries—Continued

	(000 Omitted)		Index No.'s 1929=100	
	No. of Empl's	Ingot Prod'n (Gr. Tons)	Empl's	Prod'n
1937				
Jan.	240	1,738	95	95
Feb.	245	1,639	97	90
Mar.	254	1,901	100	104
Apr.	261	1,855	103	102
May	267	1,964	105	108
Jun.	273	1,865	108	102
Jul.	277	1,695	109	93
Aug.	278	1,790	110	98
Sep.	276	1,603	109	88
Oct.	271	1,131	107	62
Nov.	256	800	101	44
Dec.	236	552	93	30
1938				
Jan.	220	685	87	38
Feb.	211	548	83	30
Mar.	205	711	81	39
Apr.	204	642	81	35
May	202	647	80	35
Jun.	197	587	78	32
Jul.	192	612	76	34
Aug.	191	764	76	42
Sep.	192	838	76	46
Oct.	197	1,047	78	57
Nov.	206	1,224	81	67
Dec.	207	1,092	82	60
1939				
Jan.	207	1,075	82	59
Feb.	209	1,037	83	57
Mar.	211	1,177	83	65
Apr.	196	1,018	77	56
May	212	963	84	53
Jun.	214	988	84	54
Jul.	214	1,047	85	57
Aug.	214	1,269	85	70
Sep.	236	1,431	93	78
Oct.				
Nov.				
Dec.				

Number of employees represents number on rolls during each month.
Ingot production data include production of ingots and castings.



During depression periods, the number of employees of U. S. Steel Corporation has not declined as much as ingot production. To a large extent, this has been due to the Corporation's policy of sharing the available work so far as practicable among the maximum number of employees.

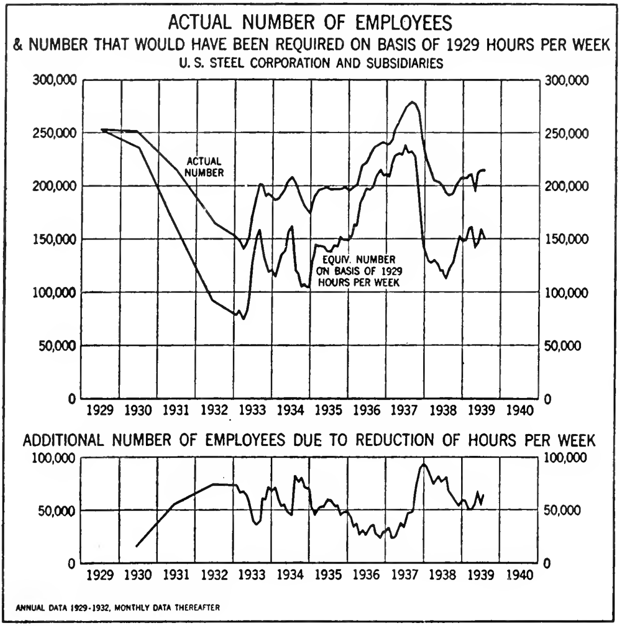
In 1937, there were more employees than in 1929, despite the fact that ingot production was less.

Actual number of employees and number that would have been required on basis of 1929 hours per week—U. S. Steel Corporation and subsidiaries

	Actual No. of Empl's	Equiv. No. Empl's (Basis '29 W'kly Hrs.)	Addtl. Number Empl'd
1929	253,138	253,138	....
1930	251,782	235,978	15,804
1931	215,223	160,029	55,194
1932	164,330	90,340	73,990
1933			
January	151,010	77,793	73,217
Feb	147,369	81,659	65,710
Mar	139,585	73,116	66,469
Apr	143,922	80,061	63,861
May	150,651	97,173	53,478
Jun	170,767	130,478	40,289
Jul	190,170	153,947	36,223
Aug	200,749	160,773	39,976
Sep	200,633	138,967	61,666
Oct	189,695	129,338	60,357
Nov	192,438	119,128	73,310
Dec	189,229	120,418	68,811
1934			
Jan	185,433	113,588	71,845
Feb	186,686	126,074	60,612
Mar	190,153	135,824	54,329
Apr	194,669	138,207	56,462
May	204,033	155,895	48,138
Jun	207,731	162,318	45,413
Jul	203,416	119,760	83,656
Aug	192,038	116,802	75,236
Sep	185,693	103,699	81,994
Oct	178,426	106,592	71,834
Nov	175,737	104,986	70,751
Dec	174,350	104,157	70,193
1935			
Jan	181,825	128,694	53,131
Feb	191,025	145,543	45,482
Mar	194,992	143,923	51,069
Apr	196,260	143,584	52,676
May	197,284	143,052	54,232
Jun	197,269	137,064	60,205
Jul	195,940	136,564	59,376
Aug	196,534	144,210	52,324
Sep	196,524	142,501	54,023
Oct	195,585	151,134	44,451
Nov	197,984	149,559	48,425
Dec	195,975	148,890	47,085
1936			
Jan	195,858	152,617	43,241
Feb	197,463	163,698	33,765
Mar	200,709	162,044	38,665
Apr	211,008	184,975	26,033
May	219,664	189,234	30,430
Jun	222,979	197,882	25,097
Jul	229,452	195,183	34,269
Aug	234,972	199,370	35,602
Sep	237,570	209,802	27,768
Oct	238,944	215,670	23,274
Nov	240,014	209,363	30,651
Dec	238,781	209,838	28,943
1937			
Jan	240,359	207,583	32,776
Feb	244,602	222,365	22,237
Mar	254,011	229,819	24,192
Apr	260,565	230,673	29,892
May	267,052	228,902	38,150
Jun	272,655	239,605	33,050
Jul	276,897	230,748	46,149
Aug	278,178	231,815	46,363
Sep	276,202	228,375	47,827
Oct	270,515	194,982	75,533
Nov	255,788	167,757	88,031
Dec	235,565	142,257	93,308
1938			
Jan	220,270	129,683	90,587
Feb	210,580	126,257	84,323
Mar	204,819	130,339	74,480
Apr	203,815	125,730	78,085
May	201,623	120,014	81,609
Jun	196,898	120,611	76,287
Jul	192,021	111,389	80,632
Aug	191,311	123,400	67,911
Sep	192,321	129,879	62,442
Oct	197,271	138,773	58,498
Nov	205,709	153,614	52,095
Dec	207,370	149,468	57,902
1939			
Jan	206,715	148,548	58,167
Feb	208,995	158,782	50,213
Mar	211,011	161,227	49,784
Apr	195,764	141,950	53,814
May	212,381	146,644	65,737
Jun	213,728	159,139	54,589
Jul	214,205	149,758	64,447

Actual number of employees represents number on rolls during each month.

Equivalent number of employees was obtained by multiplying the actual number of employees in each year or month by number of hours worked per week during the period and dividing by the number of hours worked per week during 1929.

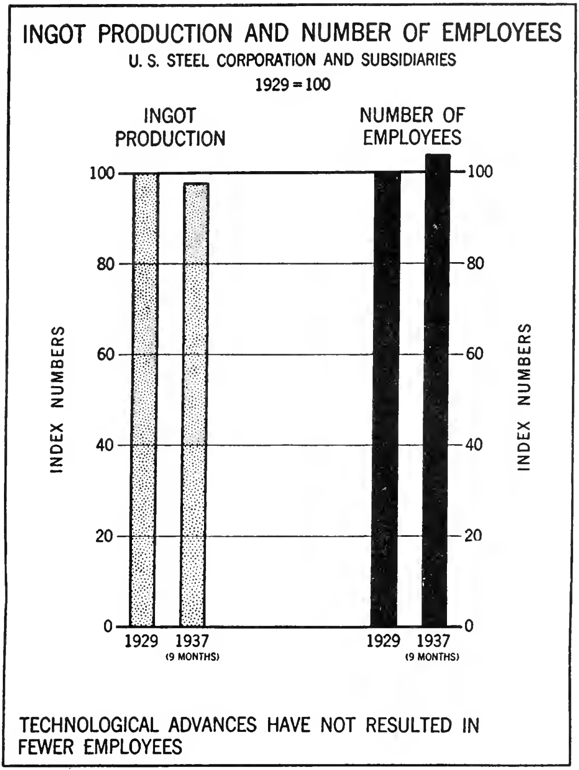


U. S. Steel Corporation's policy during recent depression years of sharing the available work so far as practicable among the maximum number of employees has made it possible to give work to a larger number of employees than would otherwise be required. The additional number of employees has varied from a minimum of about 25,000 during periods of high operating activity to a maximum of roughly 90,000 during periods of business depression.

Ingot production and number of employees—U. S. Steel Corporation and subsidiaries

Item	1929	1937 (9 months)	1937 in % of 1929
Monthly Ingot Production (Tons)	1,822,401	1,783,291	98
Number of Employees	253,138	263,391	104
Hours per Week	47.2	39.5	84
Earnings per Hour	$0.643	$0.815	127
Earnings per Week	$30.32	$32.16	106

Ingot production represents average monthly production of ingots and castings.
Number of employees represents the average number on rolls.
Hours per week, earnings per hour and earnings per week data are for all wage earners of U. S. Steel Corporation and subsidiaries.



Technological advances in the art of steel making have not resulted in fewer employees being required by U. S. Steel Corporation. The year 1929 and the first nine months of 1937 are two periods in which production of steel was comparable. Between these two periods the Corporation expended huge amounts for more modern and continuous types of equipment to keep pace with technological advances.

Average monthly ingot production in the first nine months of 1937 was 2% less than in the year 1929, whereas the average number of employees in the first nine months of 1937 was 4% more. The employees in 1937 worked about 8 hours less per week than in 1929 but, due to increases of about 27% in hourly wage rates, actually earned more per week in 1937 than in 1929.

Ingot production and number of employees—Total steel industry

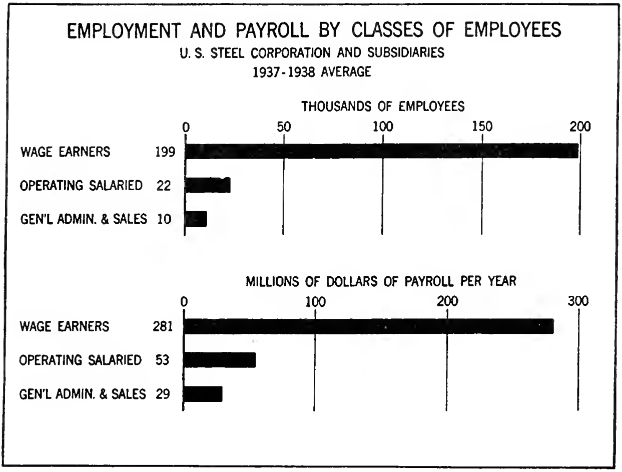
Item	1929	1937 (9 months)	1937 in % of 1929
Monthly Ingot Production (Tons)	4, 570, 869	4, 798, 000	105
Number of Employees	428, 319	521, 303	122

Ingot production represents average monthly production of all ingots, and excludes production of castings. Number of employees represents number of wage earners of iron and steel manufacturing companies reporting to American Iron and Steel Institute (1929 figure partially estimated, based on data of U. S. Census of Manufactures on wage earners in Blast Furnaces, Steel Works and Rolling Mills).

Employment and payroll by classes of employees—U. S. Steel Corporation and subsidiaries

Class of Employees	Number of Employees	Total Payroll
Wage Earners:		
1937	228, 281	$356, 510. 590
1938	170, 241	204, 543, 987
Average	199, 261	280, 527, 289
Operating Salaried:		
1937	22, 669	$55, 938, 276
1938	21, 791	49, 311, 604
Average	22, 230	52, 624, 940
Gen'l Administrative and Sales:		
1937	10, 343	$30, 478, 817
1938	10, 076	28, 353, 741
Average	10, 210	29, 416, 279

Number of employees represents the average number on rolls during the year.
Payroll figures include construction payroll.

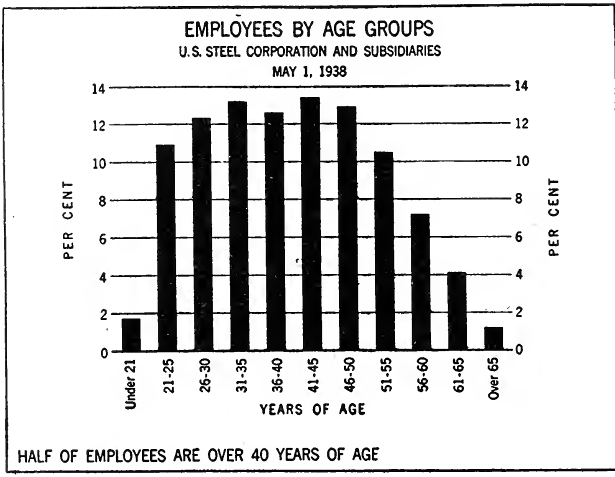


General administrative and sales employees receive only a small part of the total payroll of U. S. Steel Corporation and subsidiaries. During 1937 and 1938 wage earners and operating salaried employees, representing 95% of the working force, received 92% of the total payroll.

Employees by age groups—U. S. Steel Corporation and subsidiaries

Age Group	Number of Employees	Per Cent of Total	Age Group	Number of Employees	Per Cent of Total
Under 21 Years	3, 229	1. 7	51–55	20, 564	10. 5
21–25	21, 409	10. 9	56–60	14, 105	7. 2
26–30	24, 100	12. 3	61–65	7, 977	4. 1
31–35	25, 771	13. 2	Over 65	2, 333	1. 2
36–40	24, 560	12. 6			
41–45	26, 207	13. 4	Total	195, 567	100. 0
46–50	25, 312	12. 9			

Data are as of May 1, 1938 and cover employees carrying group life insurance; on date indicated, insured employees represented about 97% of the total of all employees.

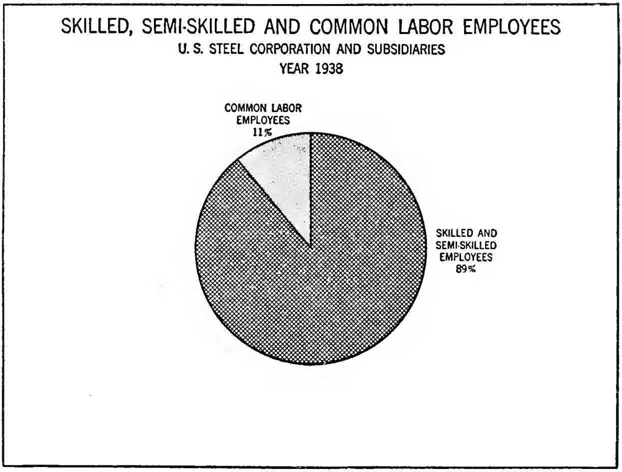


About half the employees of U. S. Steel Corporation are over 40 years of age. There are more employees between the ages of 41 and 45 than in any other group.

Skilled, semi-skilled and common labor employees—U. S. Steel Corporation and subsidiaries—year 1938

Class of Employees	Number of Employees	Per Cent of Total
Skilled and Semi-Skilled	179,672	88.9
Common Labor	22,436	11.1
Total	202,108	100.0

Number of employees represents the average number on rolls during the year.
Administrative and sales employees, representing 5% of the total in 1938, are included with skilled and semi-skilled employees.



The steel industry is one that requires skilled labor. In 1938 about 89% of all employees of U. S. Steel Corporation and subsidiaries were skilled or semi-skilled.

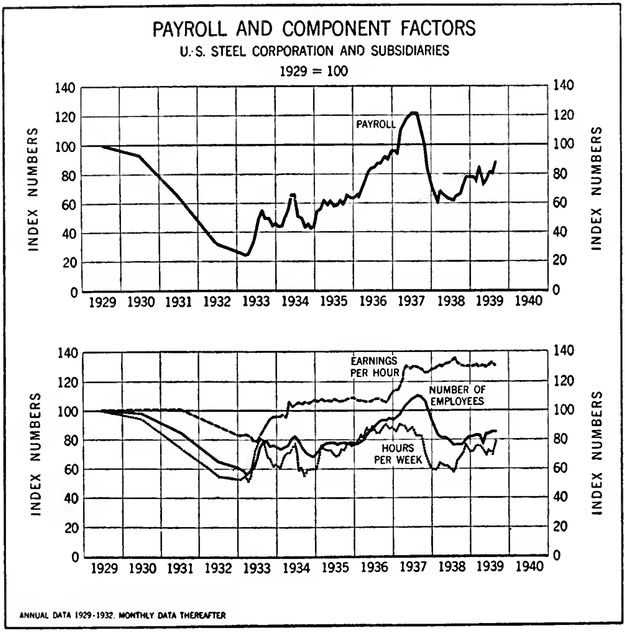
Payroll and component factors—U. S. Steel Corporation and subsidiaries

	Payroll (000 Omitted)	Number of Employees	Earnings per Hour	Hours per Week	Index Nos. 1929=100			
					Payroll	No. of Empl's	E. per Hour	H. per Week
1929	$35,006	253,138	$0.686	46.2	100	100	100	100
1930	32,606	251,782	0.687	43.3	93	99	100	94
1931	22,239	215,549	0.691	34.3	64	85	101	74
1932	11,159	164,319	0.614	25.4	32	65	90	55
	(Above represent average monthly payroll)							
				1933				
Jan	$9,070	151,010	$0.569	23.8	26	60	83	52
Feb	8,705	147,369	0.577	25.6	25	58	84	55
Mar	8,557	139,585	0.573	24.2	24	55	84	52
Apr	8,895	143,922	0.561	25.7	25	57	82	56
May	10,807	150,651	0.543	29.8	31	60	79	65
Jun	13,769	170,767	0.533	35.3	39	67	78	76
Jul	17,663	190,170	0.563	37.4	50	75	82	81
Aug	19,591	200,749	0.596	37.0	56	79	87	80
Sep	17,238	200,633	0.627	32.0	49	79	91	69
Oct	17,095	189,695	0.646	31.5	49	75	94	68
Nov	15,561	192,438	0.659	28.6	44	76	96	62
Dec	16,198	189,229	0.658	29.4	46	75	96	64
				1934				
Jan	$15,322	185,433	$0.660	28.3	44	73	96	61
Feb	15,497	186,686	0.665	31.2	44	74	97	68
Mar	18,231	190,153	0.655	33.0	52	75	95	71
Apr	19,705	194,669	0.720	32.8	56	77	105	71
May	22,648	204,033	0.710	35.3	65	81	103	76
Jun	22,741	207,731	0.706	36.1	65	82	103	78
Jul	17,527	203,416	0.717	27.2	50	80	106	59
Aug	17,282	192,038	0.723	28.1	49	76	105	61
Sep	14,972	185,693	0.730	25.8	43	73	106	56
Oct	15,779	178,426	0.723	27.6	45	70	105	60
Nov	15,226	175,737	0.730	27.6	43	69	106	60
Dec	15,572	174,350	0.731	27.6	44	69	107	60
				1935				
Jan	$19,080	181,825	$0.725	32.7	55	72	106	71
Feb	19,733	191,025	0.734	35.2	56	75	107	76
Mar	21,411	194,992	0.727	34.1	61	77	106	74
Apr	20,752	196,260	0.730	33.8	59	78	106	73
May	21,288	197,284	0.727	33.5	61	78	106	73
Jun	19,930	197,269	0.733	32.1	57	78	107	69
Jul	20,212	195,940	0.725	32.2	58	77	106	69
Aug	21,427	196,534	0.725	33.9	61	78	106	73
Sep	20,589	196,524	0.730	33.5	59	78	106	73
Oct	22,684	195,585	0.733	35.7	65	77	107	77
Nov	22,014	197,984	0.742	34.9	63	78	108	76
Dec	22,455	195,975	0.739	35.1	64	77	108	76
				1936				
Jan	$22,896	195,858	$0.733	36.0	65	77	107	78
Feb	22,201	197,463	0.733	38.3	63	78	107	83
Mar	24,167	200,709	0.728	37.3	69	79	106	81
Apr	26,662	211,008	0.730	40.5	76	83	106	88
May	28,009	219,664	0.724	39.8	80	87	106	86
Jun	28,912	222,979	0.737	41.0	83	88	107	89
Jul	29,567	229,452	0.742	39.3	84	91	108	85
Aug	30,128	234,972	0.739	39.2	86	93	108	85
Sep	30,097	237,570	0.725	40.8	86	94	106	88
Oct	31,774	238,944	0.719	41.7	91	94	105	90
Nov	31,119	240,014	0.750	40.3	89	95	105	87
Dec	33,336	238,781	0.778	40.6	95	94	113	88

Payroll and component factors—U. S. Steel Corporation and subsidiaries—Contd.

	Payroll (000 Omitted)	Number of Employees	Earnings per Hour	Hours per Week	Index Nos. 1929=100			
					Payroll	No. of Empl's	E. per Hour	H. per Week
				1937				
Jan	$33,177	240,359	$0.780	39.9	95	95	114	86
Feb	32,293	244,602	0.785	42.0	92	97	114	91
Mar	39,065	254,011	0.831	41.8	112	100	121	90
Apr	40,857	260,565	0.898	40.9	117	103	131	89
May	41,906	267,052	0.895	39.6	120	105	130	86
Jun	42,517	272,655	0.894	40.6	121	108	130	88
Jul	42,383	276,897	0.901	38.5	121	109	131	83
Aug	42,394	278,178	0.894	38.5	121	110	130	83
Sep	39,625	276,202	0.877	38.2	113	109	128	83
Oct	34,484	270,515	0.863	33.3	99	107	126	72
Nov	28,749	255,788	0.866	30.3	82	101	126	66
Dec	25,477	235,565	0.877	27.9	73	93	128	60
				1938				
Jan	$23,550	220,270	$0.887	27.2	67	87	129	59
Feb	20,923	210,580	0.896	27.7	60	83	131	60
Mar	23,842	204,819	0.892	29.4	68	81	130	64
Apr	22,655	203,816	0.908	28.5	65	81	132	62
May	22,321	201,623	0.910	27.5	64	80	133	62
Jun	21,961	196,898	0.919	28.3	63	78	134	60
Jul	21,194	192,021	0.931	26.8	61	76	136	58
Aug	22,897	191,311	0.906	29.8	65	76	132	65
Sep	23,146	192,321	0.901	31.2	66	76	131	68
Oct	25,358	197,271	0.890	32.5	73	78	130	70
Nov	27,186	205,709	0.892	34.5	78	81	130	75
Dec	27,177	207,370	0.889	33.3	78	82	130	72
				1939				
Jan	$27,223	206,715	$0.894	33.2	78	82	130	72
Feb	26,344	208,995	0.899	35.1	75	83	131	76
Mar	29,499	211,011	0.895	35.3	84	83	130	76
Apr	25,404	195,764	0.902	33.5	73	77	131	73
May	26,684	212,381	0.890	31.9	76	84	130	69
Jun	28,308	213,728	0.899	34.4	81	84	131	74
Jul	27,884	214,205	0.912	32.3	80	85	133	70
Aug	30,980	214,108	0.896	36.4	88	85	131	79

Payroll figures include construction payroll.
Number of employees represents number on rolls during month.



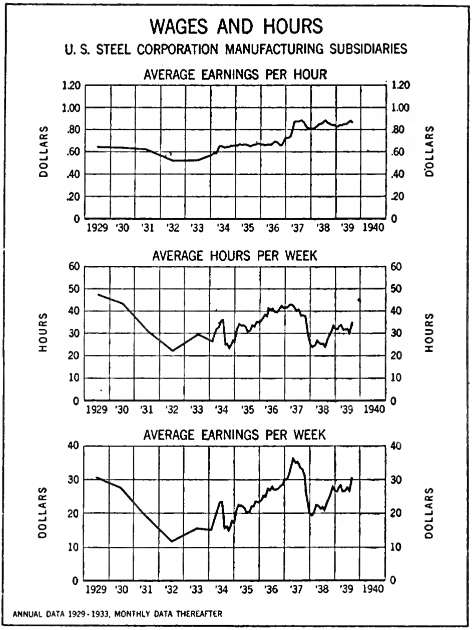
Total payroll is affected by three factors, (a) number of employees, (b) number of hours worked, and (c) hourly wage rates.

Since 1929, hourly earnings of employees of U. S. Steel Corporotion have been well maintained and since 1936 have been approximately 30% above the 1929 level. Decreases in total payroll in the depression periods have largely been due to reductions in number of employees and hours worked per week, made necessary by the absence of orders for steel products.

Wages and hours—U. S. Steel manufacturing subsidiaries

Year or Month	Average Earnings Per Hour	Average Hours Per Week	Average Earnings Per Week	Year or Month	Average Earnings Per Hour	Average Hours Per Week	Average Earnings Per Week
1929	$0.641	47.5	$30.47	Aug	$0.683	39.5	$27.04
1930	.634	43.2	27.38	Sep	.664	41.2	27.35
1931	.615	31.3	19.28	Oct	.660	42.6	28.13
1932	.518	22.0	11.42	Nov	.691	41.2	28.48
1933	.525	29.4	15.43	Dec	.725	41.5	30.07
1934	.632	28.6	18.09	Jan. '37	.726	41.4	30.06
1935	.660	33.4	22.02	Feb	.730	43.1	31.45
1936	.676	40.2	27.20	Mar	.794	43.0	34.11
1937	.825	37.4	30.84	Apr	.865	42.1	36.43
1938	.843	27.5	23.15	May	.872	40.0	34.88
Jan. '34	.580	26.3	15.27	Jun	.872	40.8	35.55
Feb	.585	29.7	17.39	Jul	.881	38.0	33.51
Mar	.586	32.1	18.79	Aug	.871	38.1	33.19
Apr	.650	32.4	21.03	Sep	.840	37.4	31.38
May	.651	35.6	23.14	Oct	.814	31.7	25.80
Jun	.645	35.9	23.18	Nov	.805	28.1	22.61
Jul	.639	24.5	15.63	Dec	.805	25.0	20.13
Aug	.648	25.3	16.37	Jan. '38	.808	24.1	19.44
Sep	.647	23.1	14.94	Feb	.820	24.7	20.21
Oct	.650	25.2	16.39	Mar	.834	27.0	22.53
Nov	.651	27.3	17.77	Apr	.853	26.1	22.27
Dec	.653	26.2	17.10	May	.856	24.9	21.31
Jan. '35	.653	32.1	20.97	Jun	.868	25.4	22.03
Feb	.661	34.3	22.66	Jul	.877	23.8	20.89
Mar	.659	33.5	22.06	Aug	.853	27.4	23.37
Apr	.662	33.5	22.19	Sep	.844	29.2	24.65
May	.660	32.8	21.65	Oct	.840	31.3	26.26
Jun	.656	30.5	20.01	Nov	.839	33.7	28.30
Jul	.650	31.2	20.25	Dec	.832	32.2	26.82
Aug	.659	33.6	22.12	Jan. '39	.832	31.9	26.54
Sep	.660	33.2	21.95	Feb	.836	33.3	27.84
Oct	.664	35.6	23.66	Mar	.841	33.9	28.54
Nov	.667	35.1	23.41	Apr	.846	31.5	26.62
Dec	.664	35.2	23.37	May	.848	31.7	26.90
Jan. '36	.663	36.5	24.17	Jun	.866	32.1	27.83
Feb	.658	38.4	25.25	Jul	.880	30.0	26.42
Mar	.659	37.9	24.99	Aug	.862	35.4	30.49
Apr	.665	41.4	27.53	Sep			
May	.661	40.5	26.77	Oct			
Jun	.680	41.5	28.20	Nov			
Jul	.687	39.4	27.07	Dec			

Data are for wage earners only, exclusive of all salaried employees.
Figures prior to 1933 are partially estimated, based on samples.



Average earnings per hour of wage earners of U. S. Steel Corporation manufacturing subsidiaries are about 30% higher today than in 1929.

Due to the Corporation's policy of sharing the available work so far as practicable among the maximum number of employees during depression periods, average hours per week reached a level in 1938 almost as low as that of 1932. With the improving demand for steel which began in the Fall of 1938, more work became available and by August 1939, average hours per week had increased to about 35½.

Average earnings per week at the low point of 1938 were substantially above the low point of 1932, on account of the higher hourly rate. In August 1939, despite a twelve hour shorter work week, weekly earnings were slightly higher than in 1929.

Wages and hours—U. S. Steel Corporation manufacturing subsidiaries and all manufacturing industries

Year or Month	Average Earnings per Hour		Average Hours per Week		Average Earnings per Week	
	U. S. Steel	All Mfrg.	U. S. Steel	All Mfrg.	U. S. Steel	All Mfrg.
1929	$0.641		47.5		$30.47	
1930	.634		43.2		27.38	
1931	.615		31.3		19.28	
1932	.518		22.0		11.42	
1933	.525	$0.460	29.4	37.9	15.43	$17.57
1934	.632	.548	28.6	34.7	18.09	19.14
1935	.660	.568	33.4	36.6	22.02	21.06
1936	.676	.575	40.2	39.1	27.20	22.82
1937	.825	.643	37.4	38.5	30.84	25.14
1938	.843	.646	27.5	35.3	23.15	22.89
Jan., '34	.580	.533	26.3	33.7	15.27	18.01
Feb	.585	.531	29.7	35.8	17.39	10.02
Mar	.586	.531	32.1	36.3	18.79	19.48
Apr	.650	.541	32.4	36.2	21.03	19.96
May	.651	.551	35.6	35.4	23.14	19.81
Jun	.645	.550	35.9	34.9	23.18	19.48
Jul	.639	.556	24.5	33.4	15.63	18.60
Aug	.648	.555	25.3	34.0	16.37	18.89
Sep	.647	.559	23.1	33.3	14.94	18.55
Oct	.650	.553	25.2	34.3	16.39	18.95
Nov	.651	.554	27.3	34.1	17.77	18.87
Dec	.653	.560	26.2	35.2	17.10	19.73
Jan., '35	.653	.564	32.1	35.2	20.97	19.99
Feb	.661	.567	34.3	36.4	22.66	20.93
Mar	.659	.568	33.5	36.6	22.06	21.09
Apr	.662	.571	33.5	36.4	22.19	21.17
May	.660	.571	32.8	35.8	21.65	20.78
Jun	.656	.575	30.5	35.4	20.01	20.54
Jul	.650	.569	31.2	35.2	20.25	20.12
Aug	.659	.568	33.6	36.6	22.12	20.85
Sep	.660	.563	33.2	37.4	21.95	21.14
Oct	.664	.564	35.6	38.2	23.66	21.64
Nov	.667	.567	35.1	37.8	23.41	21.80
Dec	.664	.572	35.2	38.7	23.37	22.33
Jan., '36	.663	.573	36.5	37.3	24.17	21.59
Feb	.658	.571	38.4	37.4	25.25	21.44
Mar	.659	.572	37.9	38.6	24.99	22.25
Apr	.665	.573	41.4	38.7	27.53	22.66
May	.661	.574	40.5	39.2	26.77	22.95
Jun	.680	.575	41.5	39.2	28.20	22.92
Jul	.687	.572	39.4	38.5	27.07	22.39
Aug	.683	.571	39.5	39.4	27.04	22.67
Sep	.664	.569	41.2	38.7	27.35	22.20
Oct	.660	.574	42.6	40.5	28.13	23.46
Nov	.691	.579	41.2	40.6	28.48	23.94
Dec	.725	.594	41.5	41.1	30.07	24.87
Jan., '37	.726	.596	41.4	39.6	30.06	24.02
Feb	.730	.602	43.1	40.4	31.45	24.73
Mar	.794	.613	43.0	41.0	34.11	25.54
Apr	.865	.638	42.1	40.4	36.43	26.30
May	.872	.649	40.0	39.8	34.88	26.39
Jun	.872	.653	40.8	39.2	35.55	26.00
Jul	.881	.657	38.0	37.9	33.51	25.31
Aug	.871	.656	38.1	38.7	33.19	25.84
Sep	.840	.658	37.4	37.4	31.38	24.92
Oct	.814	.666	31.7	37.6	25.80	25.39
Nov	.805	.667	28.1	35.4	22.61	23.92
Dec	.805	.666	25.0	34.4	20.13	22.93
Jan., '38	.808	.663	24.1	33.2	19.44	21.89
Feb	.820	.656	24.7	34.3	20.21	22.30
Mar	.834	.655	27.0	34.5	22.53	22.46
Apr	.853	.652	26.1	34.2	22.27	22.98
May	.856	.650	24.9	34.4	21.31	22.43
Jun	.868	.648	25.4	34.4	22.03	22.30
Jul	.877	.635	23.8	34.7	20.89	22.06
Aug	.853	.629	27.4	36.3	23.37	22.90
Sep	.844	.632	29.2	36.9	24.65	23.52
Oct	.840	.637	31.3	37.4	26.26	23.95
Nov	.839	.645	33.7	36.5	28.30	23.82
Dec	.832	.648	32.2	37.1	26.82	24.31
Jan., '39	.832	.651	31.9	36.3	26.54	23.86
Feb	.836	.649	33.3	36.9	27.84	24.06
Mar	.841	.651	33.9	37.1	28.54	24.23
Apr	.846	.648	31.5	36.4	26.62	23.85
May	.848	.649	31.7	36.7	26.90	23.90
Jun	.866	.648	32.1	37.2	27.83	24.23
Jul	.880		30.0		26.42	
Aug	.862		35.4		30.49	
Sep						

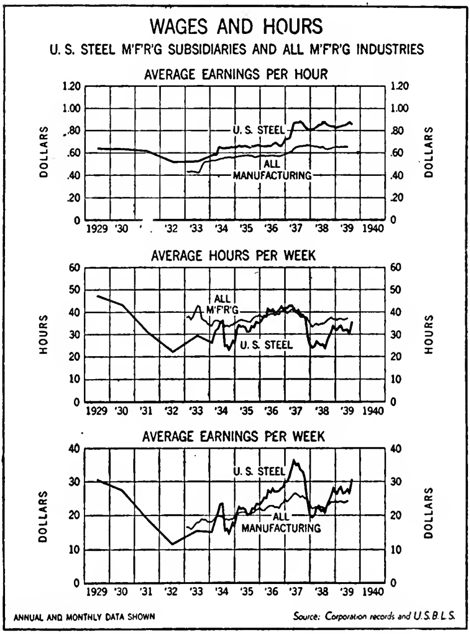
Wages and hours—U. S. Steel Corporation manufacturing subsidiaries and all manufacturing industries—Continued

Year or Month	Average Earnings per Hour		Average Hours per Week		Average Earnings per Week	
	U. S. Steel	All Mfrg.	U. S. Steel	All Mfrg.	U. S. Steel	All Mfrg.
Oct						
Nov						
Dec						

Source: Corporation records and U. S. Bureau of Labor Statistics.

U. S. Steel data are for wage earners only, exclusive of salaried employees; data prior to 1933 are partially estimated, based on samples.

Data for all manufacturing industries are those of U. S. B. L. S. and cover wage earners in 89 manufacturing industries; data are not available prior to 1932.



Average earnings per hour of wage earners in U. S. Steel Corporation manufacturing subsidiaries are considerably higher than earnings per hour in manufacturing industries generally.

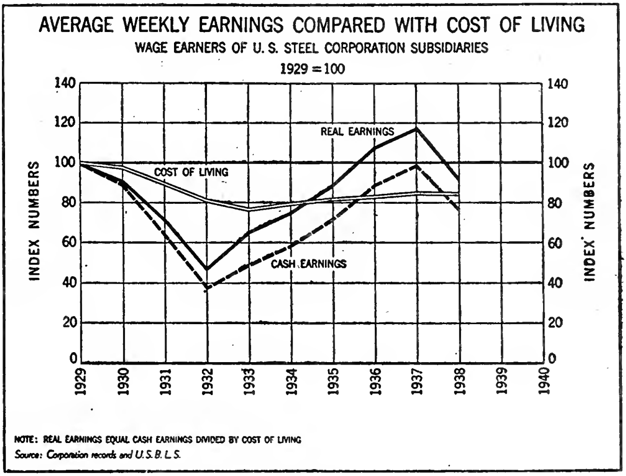
Average hours per week in Corporation subsidiaries tend to fluctuate with hours per week in all manufacturing industries but in greater degree. In periods of low operation, weekly hours in Corporation subsidiaries are below those in all manufacturing industries, and in periods of high operation they are above.

Average earnings per week in Corporation subsidiaries tend to be above those in all manufacturing industries even though hours per week in the former are the lower, as in 1939. This is because of the higher hourly rate in Corporation subsidiaries which, in 1939, was more than 20 cents an hour above that in manufacturing industries generally.

Average weekly earnings compared with cost of living—wage earners of U. S. Steel Corporation subsidiaries

Year	Cost of Living		Cash Earnings		Real Earnings 1929=100
	1923–25 =100	1929=100	Dollars per Week	1929=100	
1929	99.3	100.0	30.32	100.0	100.0
1930	97.2	97.9	27.19	89.7	91.6
1931	88.9	89.5	19.44	64.1	71.6
1932	80.3	80.9	11.48	37.9	46.8
1933	75.7	76.2	15.00	49.5	65.0
1934	78.3	78.9	17.93	59.1	74.9
1935	80.5	81.1	21.63	71.3	87.9
1936	81.9	82.5	26.79	88.4	107.2
1937	84.0	84.6	29.93	98.7	116.7
1938	83.5	84.1	23.06	76.1	90.5

Source: Corporation records and U. S. Bureau of Labor Statistics.
Yearly cost of living data computed from U. S. B. L. S. first, middle and last of year data by weighing first and last of year figures by one and the middle of the year figure by two.
Real earnings equal cash earnings divided by cost of living.



In 1938, average weekly earnings of all wage earners of U. S. Steel Corporation subsidiaries were more than 20% below those in 1929. However, since the cost of living in 1938 was also below that in 1929, real weekly earnings (i. e., cash earnings divided by cost of living) of Corporation wage earners were only 10% below the 1929 level.

With improved business conditions in 1939, weekly earnings of Corporation wage earners had recovered by August to approximately the 1929 level. At that time, the cost of living was still about 15% below the 1929 average, so that real earnings of Corporation wage earners were nearly 20% above the 1929 point.

Wage rates and steel prices

[Wage rates=U. S. Steel Corporation Mfrg. subidiaries' basic rate per hour for common labor (Pittsburgh district); steel prices=Iron Age composite price of finished steel]

STEEL PRICES (IRON AGE)

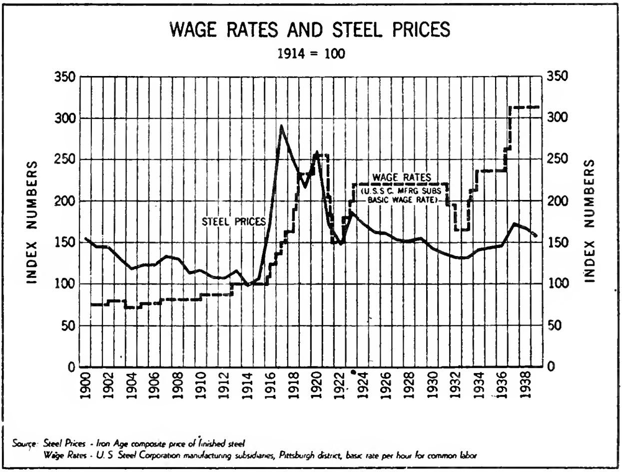
Year	Price Per Net Ton	1914=100	Year	Price Per Net Ton	1914=100
1900	$44.14	154.01	1920	$74.74	260.78
1901	40.80	142.36	1921	48.74	170.06
1902	41.14	143.55	1922	42.48	148.22
1903	37.36	130.36	1923	53.94	188.21
1904	34.14	119.12	1924	50.10	174.81
1905	35.20	122.82	1925	46.68	162.88
1906	35.40	123.52	1926	46.30	161.55
1907	38.46	134.19	1927	44.04	153.66
1908	37.30	130.13	1928	43.30	151.08
1909	32.64	113.89	1929	44.18	154.15
1910	33.52	116.96	1930	40.96	142.92
1911	30.84	107.61	1931	39.14	136.57
1912	30.54	106.56	1932	38.02	132.66
1913	33.22	115.91	1933	37.58	131.12
1914	28.66	100.00	1934	40.66	141.87
1915	30.66	106.97	1935	41.16	143.61
1916	53.34	186.11	1936	41.54	144.94
1917	83.82	292.46	1937	49.28	171.95
1918	70.84	247.17	1938	47.88	167.06
1919	62.30	217.38	1939 [1]	45.20	157.71

[1] Steel price data for 1939 are basis of first 9 months.

WAGE RATES (U. S. S. C. Subs.)

Date Effective	Rate Per Hour	1914=100	Date Effective	Rate Per Hour	1914=100
Jan. 1, 1901	$0.15	75.0	Feb. 1, 1920	$0.5128	256.4
Jun. 1, 1902	.16	80.0	May 16, 1921	.4125	206.2
Jan. 1, 1904	.145	72.5	Jul. 16, 1921	.37	185.0
Apr. 1, 1905	.155	77.5	Aug. 29, 1921	.30	150.0
Jan. 1, 1907	.165	82.5	Sep. 1, 1922	.36	180.0
May 1, 1910	.175	87.5	Apr. 16, 1923	.40	200.0
Feb. 1, 1913	.20	100.0	Aug. 16, 1923	.44	220.0
Feb. 1, 1916	.22	110.0	Oct. 1, 1931	.39	195.0
May 1, 1916	.25	125.0	May 16, 1932	.33	165.0
Dec. 16, 1916	.275	137.5	Jul. 16, 1933	.40	200.0
May 1, 1917	.30	150.0	Sep. 16, 1933	.425	212.5
Oct. 1, 1917	.33	165.0	Apr. 1, 1934	.47	235.0
Apr. 16, 1918	.38	190.0	Nov. 16, 1936	.525	262.5
Aug. 1, 1918	.42	210.0	Mar. 16, 1937	.625	312.5
Oct. 1, 1918	.4683	234.1			

From August 16, 1923 to September 16, 1933, common labor is that of 10 hour men; subsequent to September 16, 1933, rate is that of 8 hour, non-continuous labor.



Wage rates today, as represented by the common labor rate per hour of manufacturing subsidiaries of U. S. Steel Corporation in the Pittsburgh District, are more than four times as high as at the beginning of the century. Current steel prices, as represented by the Iron Age composite price of finished steel, are practically at the same level as in 1900, without attempting any adjustment for the great improvement in quality which has occurred during the interval.

Average earnings per hour and common labor rate—U. S. Steel Corporation manufacturing subsidiaries

AVERAGE EARNINGS PER HOUR—ALL WAGE EARNERS

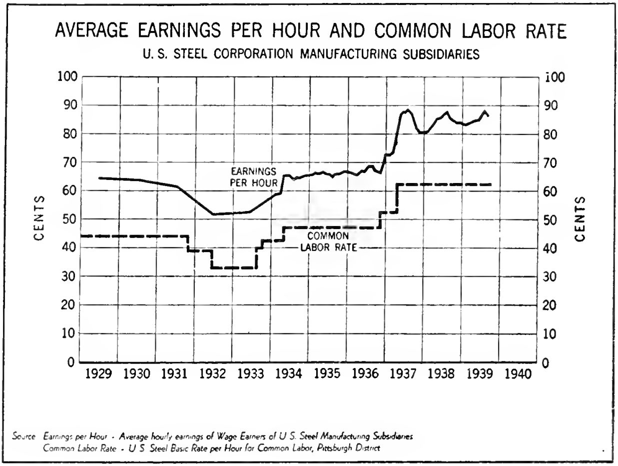
1929	$0.641	1936:	
1930	.634	Sep	$0.664
1931	.615	Oct	.660
1932	.518	Nov	.691
1933	.525	Dec	.725
1934:		1937:	
Jan	.580	Jan	.726
Feb	.585	Feb	.730
Mar	.586	Mar	.794
Apr	.650	Apr	.865
May	.651	May	.872
Jun	.645	Jun	.872
Jul	.639	Jul	.881
Aug	.648	Aug	.871
Sep	.647	Sep	.840
Oct	.650	Oct	.814
Nov	.651	Nov	.805
Dec	.653	Dec	.805
1935:		1938:	
Jan	.653	Jan	.808
Feb	.661	Feb	.820
Mar	.659	Mar	.834
Apr	.662	Apr	.853
May	.660	May	.856
Jun	.656	Jun	.868
Jul	.650	Jul	.877
Aug	.659	Aug	.853
Sep	.660	Sep	.844
Oct	.664	Oct	.840
Nov	.667	Nov	.839
Dec	.664	Dec	.832
1936:		1939:	
Jan	.663	Jan	.832
Feb	.658	Feb	.836
Mar	.659	Mar	.841
Apr	.665	Apr	.846
May	.661	May	.848
Jun	.680	Jun	.866
Jul	.687	Jul	.880
Aug	.683	Aug	.862

Data prior to 1933 partially estimated, based on samples.

COMMON LABOR RATE—COMMON LABOR EMPLOYEES IN PITTSBURGH DISTRICT

Date Effective:	*Rate per Hour*	Date Effective—Con.	*Rate per Hour*
Jan. 1, 1901	$0.15	Feb. 1, 1920	$0.5128
Jun. 1, 1902	.16	May 16, 1921	.4125
Jan. 1, 1904	.145	Jul. 16, 1921	.37
Apr. 1, 1905	.155	Aug. 29, 1921	.30
Jan. 1, 1907	.165	Sep. 1, 1922	.36
May 1, 1910	.175	Apr. 16, 1923	.40
Feb. 1, 1913	.20	Aug. 16, 1923	.44
Feb. 1, 1916	.22	Oct. 1, 1931	.39
May 1, 1916	.25	May 16, 1932	.33
Dec. 16, 1916	.275	Jul. 16, 1933	.40
May 1, 1917	.30	Sep. 16, 1933	.425
Oct. 1, 1917	.33	Apr. 1, 1934	.47
Apr. 16, 1918	.38	Nov. 16, 1936	.525
Aug. 1, 1918	.42	Mar. 16, 1937	.625
Oct. 1, 1918	.4683		

From August 16, 1923, to September 16, 1933, common labor rate is that of 10-hour men; subsequent to September 16, 1933, rate is that of 8-hour, non-continuous labor.



The common labor rate at Pittsburgh is a good measure of the trend of earnings per hour of employees of U. S. Steel Corporation manufacturing subsidiaries.

Vacation wages paid in the summers of 1937, 1938 and 1939 caused the increases in earnings per hour during those periods. Vacation wages paid to wage earners of manufacturing subsidiaries in 1937 and 1938 amounted to $3,744,346 and $3,114,134, respectively.

Earnings per hour and steel prices—Earnings per hour—Earnings per hour of all employees of U. S. Steel Corporation and subsidiaries; steel prices—Iron Age composite price of finished steel

	Hourly Earnings		Steel Prices	
	cents per Hr.	1926=100	cents per lb.	1926=100
1929	68.6	102.8	2.209	95.4
1930	68.7	103.0	2.048	88.5
1931	69.1	103.6	1.957	84.5
1932	61.4	92.1	1.901	82.1
1933				
Jan	56.9	85.3	1.885	81.4
Feb	57.7	86.5	1.873	80.9
Mar	57.3	85.9	1.867	80.6
Apr	56.1	84.1	1.817	78.5
May	54.3	81.4	1.802	77.8
Jun	53.3	79.9	1.820	78.6
Jul	56.3	84.4	1.878	81.1
Aug	59.6	89.4	1.883	81.3
Sep	62.7	94.0	1.890	81.6
Oct	64.6	96.9	1.950	84.2
Nov	65.9	98.8	1.933	83.5
Dec	65.8	98.7	1.945	84.0
1934				
Jan	66.0	99.0	1.945	84.0
Feb	66.5	99.7	1.945	84.0
Mar	65.5	98.2	1.945	84.0
Apr	72.0	107.9	1.988	85.9
May	71.0	106.4	2.118	91.5
Jun	70.6	105.8	2.118	91.5
July	71.7	107.5	2.056	88.8
Aug	72.3	108.4	2.056	88.8
Sep	73.0	109.4	2.056	88.8
Oct	72.3	108.4	2.056	88.8
Nov	73.0	109.4	2.056	88.8
Dec	73.1	109.6	2.056	88.8
1935				
Jan	72.5	108.7	2.056	88.8
Feb	73.4	110.0	2.056	88.8
Mar	72.7	109.0	2.056	88.8
Apr	73.0	109.4	2.056	88.8
May	72.7	109.0	2.056	88.8
Jun	73.3	109.9	2.056	88.8
Jul	72.5	108.7	2.056	88.8
Aug	72.5	108.7	2.056	88.8
Sep	73.0	109.4	2.056	88.8
Oct	73.3	109.9	2.062	89.1
Nov	74.2	111.2	2.062	89.1
Dec	73.9	110.8	2.062	89.1
1936				
Jan	73.3	109.9	2.062	89.1
Feb	73.3	109.9	2.040	88.1
Mar	72.8	109.1	2.021	87.3
Apr	73.0	109.4	2.028	87.6
May	72.4	108.5	2.028	87.6
Jun	73.7	110.5	2.033	87.8
Jul	74.2	111.2	2.091	90.3
Aug	73.9	110.8	2.091	90.3
Sep	72.5	108.7	2.096	90.5
Oct	71.9	107.8	2.116	91.4
Nov	75.0	112.4	2.116	91.4
Dec	77.8	116.6	2.199	95.0
1937				
Jan	78.0	116.9	2.249	97.1
Feb	78.5	117.7	2.249	97.1
Mar	83.1	124.6	2.459	106.2
Apr	89.8	134.6	2.512	108.5
May	89.5	134.2	2.512	108.5
Jun	89.4	134.0	2.512	108.5
Jul	90.1	135.1	2.512	108.5
Aug	89.4	134.0	2.512	108.5
Sep	87.7	131.5	2.512	108.5
Oct	86.3	129.4	2.512	108.5
Nov	86.6	129.8	2.512	108.5
Dec	87.7	131.5	2.512	108.5
1938				
Jan	88.7	133.0	2.512	108.5
Feb	89.6	134.3	2.512	108.5
Mar	89.2	133.7	2.512	108.5
Apr	90.8	136.1	2.512	108.5
May	91.0	136.4	2.506	108.3
Jun	91.9	137.8	2.459	106.2
Jul	93.1	139.6	2.300	99.4
Aug	90.6	135.8	2.300	99.4
Sep	90.1	135.1	2.293	99.0
Oct	89.0	133.4	2.255	97.4
Nov	89.2	133.7	2.286	98.7
Dec	88.9	133.3	2.286	98.7
1939				
Jan	89.4	134.0	2.286	98.7
Feb	89.9	134.8	2.286	98.7
Mar	89.5	134.2	2.286	98.7
Apr	90.2	135.2	2.286	98.7
May	89.0	133.4	2.256	97.5
Jun	89.9	134.8	2.236	96.6
Jul	91.2	136.7	2.236	96.6
Aug	89.6	134.3	2.236	96.6

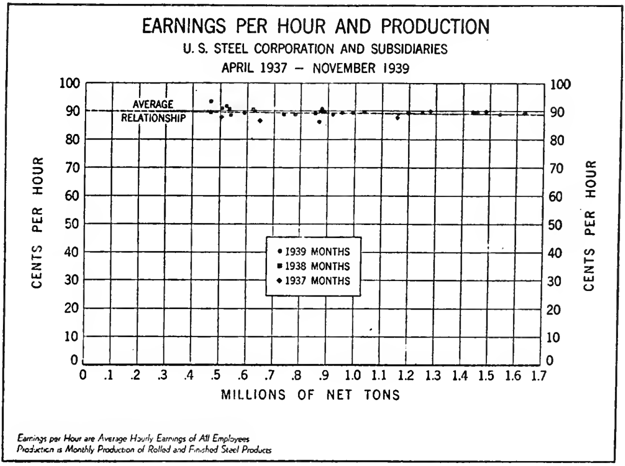
Steel prices are monthly averages of weekly figures.

The 1926 base for earnings per hour of all employees of U. S. Steel Corporation and subsidiaries was estimated from data on the total steel industry compiled by National Industrial Conference Board, as Corporation data are not available prior to 1929.

Earnings per hour and production—U. S. Steel Corporation and subsidiaries—April 1937–November 1939

Month	1937		1938		1939	
	Earnings Per Hour	Thousands of Net Tons Produced	Earnings Per Hour	Thousands of Net Tons Produced	Earnings Per Hour	Thousands of Net Tons Produced
Jan.			$0.887	537	$0.894	951
Feb.			.896	467	.899	879
Mar.			.892	587	.895	993
Apr.	$0.898	1,483	.908	532	.902	873
May	.895	1,452	.910	506	.890	919
Jun.	.894	1,438	.919	522	.899	885
Jul.	.901	1,278	.931	466	.912	879
Aug.	.894	1,247	.906	623	.896	1,033
Sep.	.877	1,154	.901	625	.893	1,198
Oct.	.863	869	.890	734	.890	1,537
Nov.	.866	648	.892	852	.893	1,629
Dec.	.877	504	.889	777		

Average relationship: Earnings per hour=$0.901 minus $0.0007 for each hundred thousand net tons produced.
Earnings per hour are average hourly earnings of all employees.
Production data represent monthly production of rolled and finished steel products.

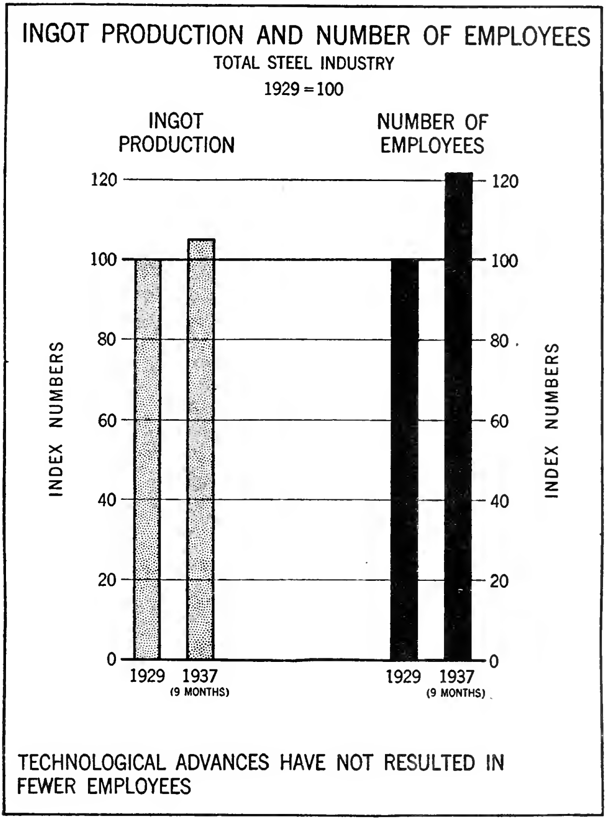


While average hourly earnings of all employees of United States Steel Corporation and subsidiaries vary somewhat from month to month, the variations are small and bear very little relation to the rate of production. Average hourly earnings tend to be less than one cent per hour lower when operations are at 90% of capacity than when operations are at 25% of capacity.

Ingot production and number of employees, total steel industry

Item	1929	1937 (9 months)	1937 in % of 1929
Monthly Ingot Production (Tons)	4,570,869	4,798,000	105
Number of Employees	428,319	521,303	122

Ingot production represents average monthly production of all ingots, and excludes production of castings.
Number of employees represents number of wage earners of iron and steel manufacturing companies reporting to American Iron and Steel Institute (1929 figure partially estimated, based on data of U. S. Census of Manufactures on wage earners in Blast Furnaces, Steel Works and Rolling Mills).



From 1929 to 1937, a period marked by important installations of continuous types of equipment to keep pace with technological advances, employment increased relatively more in the steel industry generally than it did in the U. S. Steel Corporation. Average monthly ingot production for the industry in the first nine months of 1937 was 5% more than in 1929, whereas the average number of employees in the first nine months of 1937 was 22% more.

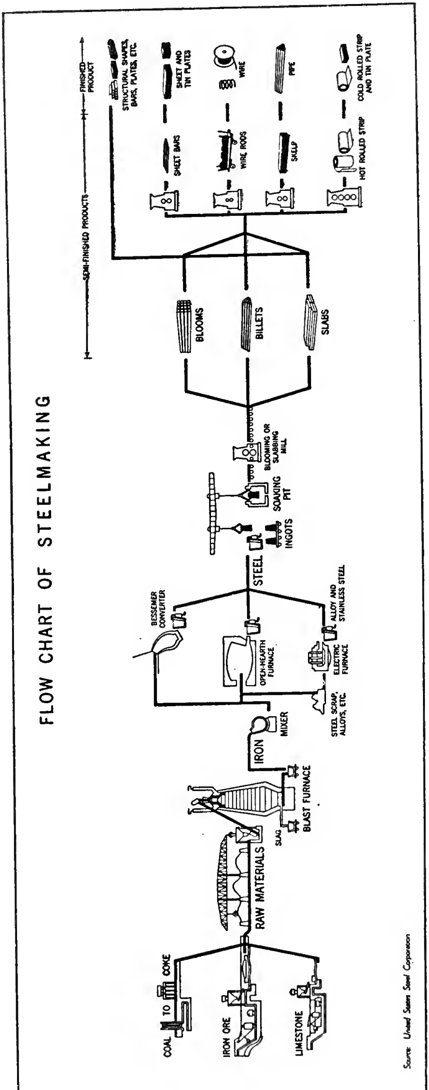

FLOW CHART OF STEELMAKING
COAL TO COKE
IRON ORE
LIMESTONE
RAW MATERIALS
SLAG
BLAST FURNACE
IRON
MIXER
BESSEMER CONVERTER
OPEN-HEARTH FURNACE
STEEL SCRAP, ALLOYS, ETC.
ELECTRIC FURNACE
ALLOY AND STAINLESS STEEL
STEEL
INGOTS
SOAKING PIT
BLOOMING OR SLABBING MILL
BLOOMS
BILLETS
SLABS
SEMI-FINISHED PRODUCTS
FINISHED PRODUCT
STRUCTURAL SHAPES, BARS, PLATES, ETC.
SHEET BARS
SHEET AND TIN PLATES
WIRE RODS
WIRE
SKELP
PIPE
HOT ROLLED STRIP
COLD ROLLED STRIP AND TIN PLATE
Source: United States Steel Corporation

EXHIBIT No. 1410

SOME FACTORS IN THE PRICING OF STEEL

This is an analysis made in connection with studies by the United States Steel Corporation in preparation for hearings on the steel industry before the Temporary National Economic Committee.

OCTOBER 30, 1939.

TABLE OF CONTENTS

INTRODUCTION

How much does the price of steel influence the quantity sold? What is the relationship of cost to the price of steel? What degree of price competition is desirable, and possible, in the steel industry? Why does the steel industry quote delivered prices and why does it use the basing point method of quoting delivered prices? Does the steel industry perform its proper function in the national economy? Before these questions can be answered a careful analysis must be made of the fundamental factors underlying the demand-supply situation in the industry.

Subject to some exceptions with respect to particular products, the salient characteristics of demand and supply in the steel industry may be summarized as follows:

(1) The demand for steel is marked by tremendous cyclical fluctuations.
(2) The total demand for steel is inelastic, i. e., the total quantity of steel bought from the industry would not be greatly different at any particular time if the price were higher or lower.
(3) In contrast, the demand for steel from a particular producer usually possesses great potential elasticity. In other words, buyers will readily shift from one producer to another in response to a difference in price. This is due to the informed character of the buying of steel. Buyers have excellent technical knowledge of the product to be purchased; and since nearly all steel is purchased on specification, the identical grade and type of steel may be obtained for the most

part from any one of a number of producers. Furthermore, the large size of individual purchases makes it worth-while for buyers to shop for the lowest possible price.

(4) The cost structure in the industry is marked by substantial fixed costs which must be met regardless of the amount of steel produced.[1] Even more significant is the fact indicated by the operating experience of the United States Steel Corporation and its subsidiaries over the past ten years that the additional cost per unit of output remains approximately the same regardless of the rate of operations provided labor rates, prices of raw materials, etc. remain constant. As a result of these two characteristics the average cost of each unit of the entire output is higher than the additional cost per additional unit of output for practically the whole range of operations up to the limits of practical capacity. Finally, the cost of labor and of other goods and services purchased from others (which together constitute about 80 percent of the total cost in the case of the subsidiaries of United States Steel Corporation), are largely outside the control of the management of the steel producer.

(5) Producers of the great bulk of the tonnage of steel products sold in the respective consuming areas are relatively few in number.

These characteristics of the steel industry, of course, do not coincide with the conditions necessary for the "perfect" price competition of classical economic theory. The theory of "perfect" price competition, for example, assumes each buyer and seller to be too small to influence the market price; any seller is supposed to be able to reduce his price and expand his production without fear of reactions on the part of competitors. This is not true of the market for steel. As a consequence of potential shiftability of buyers in response to price concessions, there is an incentive to obtain business by price reduction even below average cost as long as the price of the additional units so sold is above the additional cost thereof, but in actual competition in the steel industry such a tendancy is modified to some extent by the difficulty of continuing to offer lower prices than competitors since competitors meet price concessions almost immediately. Furthermore, "perfect" price competition does not take into account the consequences of the presence in the market of relatively few, but large, buyers, nor the size of their individual orders. It overlooks the relative difficulty of new producers entering the market and many other factors of importance in the competitive situation in the steel industry. In appraising this situation it should be recognized that the conditions requisite for theoretically "perfect" price condition have rarely, if ever, been approached in any industry, and could never be generally achieved in a manufacturing industry such as steel. Accordingly, it is hardly reasonable to judge competitive practives in the steel industry by imaginary standards based on abstract conditions which cannot possibly be fulfilled, and which probably never have been fulfilled in any industry.

Waiving the reasonableness of the application of the criteria, it is pertinent to inquire what the consequence of "perfect" price competition would be in the steel industry. If such a theoretical state of competition prevailed, each producer would take all the business he could get so long as the price yielded more than the additional cost of producing the additional ton of steel so sold. If the demand exceeded the capacity of existing producers, the price of steel would sky-rocket, being limited only by the magnitude of the demand. If, however, the demand declined to less than the existing capacity, the price would drop abruptly to the level of the additional cost per additional unit of the least efficient producer remaining in the market. In such a situation producers would cover little, if any, of their overhead. Producers, therefore, would be operating at heavy losses whenever existing capacity was not being fully utilized, and would recoup these losses by high prices and large profits during the peak of prosperity. In major depressions the efficient as well as the marginal concern would fail to survive unless it had accumulated an extraordinarily large cash balance.[2] Under such conditions existing capacity would be reduced with the result that the steel industry would become a bottle-neck in the succeeding rise in the business cycle by limiting the possibility of increased production and creating a premature boom in prices before the rest of the economy could achieve full employment.

[1] In the case of the subsidiaries of United States Steel Corporation these costs are approximately 30% of total cost at 40% of capacity operations, 20% at 70% capacity and 15% at 100% capacity.

[2] If the subsidiaries of United States Steel Corporation sold steel at a price only equal to the additional cost of additional units of production, it is estimated that the loss to the Corporation would be approximately $182,100,000 a year. Under these conditions the Corporation could not survive for more than a few years.

Actually, of course, these characteristics of "perfect" price competition would not be tolerated. The cut-throat struggle in depression and the sharp increases in prices and profits in prosperity, as well as the bottle-neck in capacity, would be the object of attacks by legislators, economists and others.

This paper is an attempt to outline the numberous factors involved in the pricing of steel with the hope that a re-statement of fundamentals will contribute to a clearer understanding of prices and price structure in the steel industry.

The Demand for Steel

IMMEDIATE SOURCE OF DEMAND

Orders for steel come mostly from companies using the products of the steel industry as raw materials in making goods or as equipment in producing services. Companies purchasing steel have been classified, and estimates of the percentage of the total steel production of the United States purchased by each class have been made as follows:

Percentage Distribution of Hot Rolled Iron and Steel Production Among Major Consuming Industries [1]

Industry	1938	1932–38 Average	1926–31 Average
Automotive	17.3	20.8	16.3
Construction	18.8	16.0	19.9
Railroads	6.1	10.1	17.9
Container	9.1	8.4	4.7
Agriculture	4.7	6.0	6.0
Oil, Gas and Water	7.4	6.0	8.3
Exports	7.5	5.5	5.9
Machinery	3.5	4.2	3.8
Furniture and Furnishings	3.6	3.6	----------
Shipbuilding	1.6	0.9	0.9
Mining	0.3	0.5	0.7
Miscellaneous	20.1	18.0	[2] 15.6

[1] M. W. Worthing, *Distribution of Steel Products to Major Consuming Industries*, United States Steel Corporation, October 30, 1939. Computations made by apportioning individual hot-rolled product totals on the basis of Iron Age distribution reports and by allocating jobber shipments to ultimate consumers.

[2] "Miscellaneous" for the period 1926–31 includes "Furniture and Furnishings."

In connection with the above classification interesting observations may be made. First, the purchasers of steel are principally companies engaged in the production of producers' and consumers' durable goods. An exception is the container industry which manufactures tin cans, an article classified as a perishable good since it is generally used but once and discarded. Second, in recent years there has been a marked increase in the percentage of steel purchased by consumers' durable goods industries, such as the automotive and household appliance industries, and a decrease in the percentage of steel purchased by producers, durable goods industries, such as the railroad industry. In this connection "Miscellaneous," which has shown such rapid growth, includes many industries producing consumers' durable goods such as refrigerators, air conditioning units, stoves, etc. Third, "Exports" in some years account for an appreciable amount of total steel sold. Since the economics of export trade involves conditions not present in the domestic market, the subject of prices and pricing methods in the steel export trade have not been included in this study.

Most industries purchasing steel are characterized by large companies; in the automotive, container, agricultural implements, household durable goods and shipbuilding industries, a relatively few large companies comprise a substantial percentage of the total production of their respective industries.[3] In purchasing their steel requirements these large companies usually come into the market with orders of considerable magnitude. The demand for steel therefore consists, to a great degree, in large-sized orders placed by relatively few companies.[4]

[3] *Big Business: Its Growth and Its Place*, Chart 3, p. 42 (Twentieth Century Fund.) *Exhibit No. 896 submitted to the T. N. E. C.*, July 11, 1939, (based on Census of Manufactures).

[4] Sales statistics of the subsidiaries of United States Steel Corporation show that in 1937, 941 customers had billings over $100,000 each and accounted for 73% of gross sales; in 1938, 663 customers had billings over $100,000 each and accounted for 68% of gross sales.

GEOGRAPHIC DISTRIBUTION

Orders for steel arise for the most part in concentrated geographical areas. The bulk of tonnage business originates in a belt extending east of the Mississippi, and north of the Ohio rivers, tapering off toward Philadelphia and New York; but important markets exist outside this zone, particularly for products required by the oil and canning industries. Although major markets for particular steel products vary both as to location and degree of importance, the principal centers of the composite demand for steel in their general order of precedence are: [5]

1. Detroit	6. Youngstown	11. Cincinnati
2. Chicago-Gary	7. Milwaukee	12. Houston
3. Pittsburgh	8. San Francisco	13. Buffalo
4. Cleveland	9. Newark	14. St. Louis
5. Los Angeles	10. New York	15. Toledo

CHARACTERISTICS OF DEMAND

The demand for steel is subject to tremendous cyclical fluctuations. This is due primarily to the great cyclical fluctuations in the demand for producers' and consumers' durable goods in the manufacture of which steel is consumed.

DERIVED NATURE OF DEMAND

The demand for new durable goods is highly sensitive to changes in the demand for services which the durable goods perform. This may be demonstrated by a simple theoretical illustration. A railroad needs five hundred cars filled to capacity to carry 10,000,000 passengers a year. Each year fifty cars normally wear out and are replaced. More people decide to travel by railroad and passenger traffic increases 10 percent, so that 11,000,000 passengers a year must be accommodated. This requires fifty more cars which must be acquired immediately to meet the increased demand for passenger service. Therefore, in the year that this increase occurs the railroad has to buy one hundred cars instead of the fifty usually purchased for the normal replacement program. Thus a 10 percent increase in the demand for passenger service results in a 100 percent increase in the demand for railroad passenger cars. This is sometimes called by economists the "acceleration principle." It works in reverse too. If passenger traffic decreased 10 percent there would not be any demand at all for new passenger railroad cars; since only four hundred and fifty cars would be required to carry the 9,000,000 passengers left, no additional cars would be needed to replace the fifty worn out. In other words, a 10 percent decrease in demand for passenger service would cause a 100 percent decrease in the demand for new durable goods to perform such service.

DURABILITY AND DEMAND

The longer the life of durable goods the more sensitive is the demand for the new durable goods to changes in the demand for services. For example, in the simple theoretical illustration given above the average life of the railroad car was presumed to be ten years. Fifty cars normally had to be replaced annually. However, if the average life had been five years, 100 cars per annum would have to be replaced. In that event a 10 percent increase in the demand for passenger service would have resulted in only a 50 percent increase in the demand for new railroad cars, and a 10 percent decrease in the demand would have resulted in a 50 percent decrease in the demand for new equipment. On the other hand, if the average life of a car had been twenty years, only twenty-five cars would have to be replaced annually. Therefore a 10 percent increase in the demand for service would have caused 200 percent increase in the demand for new railroad cars. In the event of a 10 percent decrease in the demand for service, the replacement demand for new equipment would not only disappear entirely, but twenty-five additional cars theoretically would be removed from service and be available to meet the normal replacement demand in the following year.

Thus, while the demand for new durable goods is highly sensitive to change in the demand for services which the durable goods perform, the degree of such sensitivity and the magnitude of the resultant fluctuation in demand depends on

[5] Based on estimates made in 1937 for the subsidiaries of the United States Steel Corporation of a "normal" industry-wide market for the following products: heavy rails; heavy structural shapes; plates, sheared and universal; fabricated structural work; merchant bars, including reinforced concrete bars and light structural shapes; black sheets; galvanized sheets; hot rolled strip; rods, wire and wire products; tin mill products; pipe and tubing.

the life span of the durable goods; fluctuations in the demand for new durable goods will be progressively greater as durability increases. In actual practice many qualifications to this principle exist,[6] nevertheless it is fundamental in the demand for durable goods.

POSTPONABILITY OF PURCHASE OF DURABLE GOODS

The purchase of durable goods usually can be easily postponed, and is postponed when income is scant or prospects for the profitable use of additional durable goods are discouraging. As a result of postponability of purchase, producers' durable goods industries feel an immediate effect on demand resulting from the contraction of producers' income as expenditures for capital goods are deferred and the income of the purchaser is directed primarily to meeting necessary out-of-pocket expenses. In addition, even though the immediate business outlook is favorable, expenditures for capital equipment may be postponed if the long term business outlook is unfavorable; the business man must anticipate a reasonable return over the life of the investment before tying up his capital in durable equipment. After a prolonged depression, with purchases of durable goods almost completely eliminated, increased profits and returning confidence as to the future may stimulate a great upward surge in the demand for replacements previously postponed and also for new equipment for expansion.

In like manner, consumers' durable goods industries feel the impact of declining consumer income, as funds available are used to buy the necessities of life and existing consumers' durable goods, such as automobiles, are made to last longer than anticipated, or are discarded without replacement under stringent conditions. Increased consumer income, actual and anticipated, will create a strong revival in demand for consumers' durable goods as replacements are made and new equipment purchased.

As previously indicated, the "acceleration principle" becomes more potent as durability of a product increases. As a result the magnitude of expansion and contraction in demand for products of the durable goods industries will be greater than for non-durable goods industries. These fluctuations of demand for new durable goods will be further magnified by the postponability of purchase of these goods; a producer will buy coal, oil or electrical energy long after he has decided he must postpone purchase of capital equipment, and a consumer must buy food, clothing and other necessities even though he cannot afford a new car or a refrigerator.

TOTAL DEMAND FOR STEEL IS INELASTIC

The magnitude of these cyclical fluctuations in demand cannot be materially affected by adjustments in the price of steel because the total demand for steel is inelastic. This is due, first, to the derived nature of the demand for steel, and, second, to the limited number of substitutes for basic steel products, and conversely the limited number of products for which steel may be substituted.

As previously indicated, the demand for steel is derived from the demand for the services which products made of steel perform. If a change in the price of steel is to influence the demand for the finished product in which the steel is used, two conditions must exist: the cost of steel must represent a substantial percentage of the selling price of the finished article, and the demand for the finished article itself must be such that it responds to changes in its price. This is not generally the case; steel as a raw material usually represents a small percentage of the total cost of the finished product, and the major industries purchasing steel have a rather inelastic demand for their products.[7]

The automotive industry, which during recent years has been the largest single customer of the steel industry, is a typical example of the derived nature of the demand for steel and the resultant inelasticity of such demand. The cost of steel in a low-priced automobile retailing between $700.00 and $800.00 is about $85.00, or roughly 10 percent of the retail price. Roos and von Szeliski in a recent study

[6] (a) The actual age distribution of the stock of durable goods in use might change in different years (b) The effect of obsolescence is to increase replacement rates and therefore limit the magnitude of fluctuations, if it is a constant factor from year to year. If an erratic factor, it would increase the fluctuations if it occurred in normal or above normal years, or if it occurred in sub-normal years it would limit the fluctuation. (c) For producers' durable goods, obsolescence can be brought about by shifts in demand, the development of new products, the introduction of new techniques of production, discovery of new resources or new methods of using resources, migration of industry from one area to another, and similar changes. In the field of consumers' durable goods, style changes and shifts in consumers' demands are among the causes which may result in shortening the otherwise useful life of durable goods.

[7] The approximate proportion of steel cost in price of finished product for various items is as follows: mile of railroad, 36.7%; apartment building, 10%; automobile, 10%; can of food, 8%; frame house, 6.2%; electric refrigerator, 3.4%; dairy barn, 3.2%; mile of reinforced highway, 0.7%.

contained in "The Dynamics of Automobile Demand" [8] estimated 1.5 to be a representative average of elasticity of demand for new automobiles; i. e., for every 1 percent decrease in the price, the automobiles sold would increase 1.5 percent. Since steel costs represent 10 percent of retail price, a 5 percent decrease in steel prices would permit a 0.5 percent reduction in the price of automobiles, and according to such elasticity of demand would increase automobile sales to the extent of 0.75 percent. The resultant increase in the demand for steel by the automobile industry would be negligible.

EFFECT OF THE SUBSTITUTION FACTOR

Substitution of steel for other materials, or a reverse substitution, is not an important factor in the cyclical fluctuations in the demand for steel. If, through lower prices, steel could invade a major market served by other products, or if high relative steel prices meant invasion of major steel markets by substitute products, there would be imparted to the total demand for steel a degree of elasticity not now present. Steel possesses more physical strength per dollar of investment than any other existing product; wood and concrete have a restricted field in which they may be substituted for heavy steel. Glass, plastics, rubber, aluminum and certain alloys may serve as substitutes in specialized fields; but even in these cases price may be only one of many competitive factors involved. Therefore, price reduction would result in very little additional steel being sold as substitutes for other products, and a price advance, unless abnormal, probably would not result in additional competition from substitute products.

POTENTIAL ELASTICITY OF DEMAND FROM A PARTICULAR PRODUCER

Although the over-all demand for steel is inelastic and the total quantity bought would not be substantially different if the price within reasonable limits were lower or higher, the demand for steel from a particular producer possesses great potential elasticity. This readiness of a buyer to shift from one producer to another because of a lower price is due to the informed character of the buying of steel. Technical knowledge of the product to be purchased is available through laboratories of individual purchasers, trade associations and independent research agencies; exactly the same steel may, for the most part, be obtained from any one of a number of producers. Furthermore, the large size of individual purchases makes it worth-while for buyers to seek the lowest possible price. This propensity to shop is enhanced by knowledge of latest price quotations, by familiarity with psychological and other factors resulting in a "buyers" or a "sellers" market for all or particular products, and by a general understanding of approximate costs of steel production; indeed, a few purchasers [9] of steel operate completely integrated steel works to supply a portion of their requirements, and others [10] have semi-integrated and non-integrated capacity.

Thus, potentially, the demand for steel from an individual producer is elastic and buyers are often in a position to exert bargaining pressure to obtain the lowest possible prices, especially when the steel industry is not operating near capacity.

THE SUPPLY OF STEEL

GEOGRAPHIC CONCENTRATION

The most economical source of steel is that location at which the raw materials can be assembled, the steel produced and delivery to the market effected at the lowest possible total cost. In determining plant location [11] assembly costs are most important; more than four tons of raw materials must be assembled for every ton of steel produced. Although production costs are subject to variations due primarily to geographical wage rate differentials, these variations are supplementary to and, in a measure, compensatory for otherwise uneconomical assembly or delivery costs.

The approximate amounts of principal raw materials required per ton of pig iron are: 4075 pounds of iron ore (assuming ore of a reasonably high metallic content), 2700 pounds of coking coal and 900 pounds of limestone. Another 1500 pounds of coal may be consumed for power and heating before a ton of finished

[8] Publication of the General Motors Corporation based upon papers presented at a joint meeting of the American Statistical Association and the Econometric Society in Detroit, Michigan, on December 27, 1938.

[9] Ford Motor Company and International Harvester Company.

[10] American Car and Foundry Co.; American Locomotive Co.; Atchison, Topeka and Santa Fe Railroad Co.; Continental Can Co.; Simonds Saw and Steel Co.; Timken Roller Bearing Co., Inc.

[11] Availability of a large water supply is important in steel mill location.

steel product has left the mills. The greater proportion of the raw materials is used in the blast furnace, but integrated steel works have developed from blast furnace plants because (a) as steel approaches the finished stage the cost of shipment becomes a smaller percentage of the cost of the product to the buyer; (b) integration assures more constant and reasonably full utilization of blast furnaces and open hearths; (c) economies of converting molten iron into steel and other heat conservation factors are important in the economical production of steel.

Limitations imposed by the necessity for the most favorable combination of assembly, production and delivery costs have confined steel production to a few geographical areas.

The most favorable combination of the three variables is probably to be found at Lake Erie and Lake Michigan ports and in the Pittsburgh district (including the Mahoning and Ohio Valleys). These locations[12] were primarily determined by the assembly costs of Lake Superior ores which are the backbone of the steel industry in the United States and supply about 82 percent of the ore consumed in the country, and of the finest metallurgical coking coals which are found in Western Pennsylvania, West Virginia and Kentucky. The assembly cost of limestone, which is well distributed and the least important of the major raw materials, is usually an incidental factor.

Comparative assembly costs at principal production centers in this area have been estimated as follows:

Estimated Assembly Costs in the Production of Pig Iron, Summer of 1937 [1]

[In dollars per gross ton of pig iron]

Producing Center	Iron Ore	Coal	Flux	Total	Annual Blast-Furnace Capacity	
					Thousands of Gross Tons	Percentage of U. S. Total
Weirton-Steubenville	$5.508	$0.468	$0.337	$6.313	2,093	4.2
Pittsburgh	5.804	0.284	0.337	6.425	11,521	23.0
Cleveland	3.497	2.714	0.241	6.452	2,685	5.4
Buffalo	3.497	2.909	0.241	6.647	3,267	6.5
Detroit	3.497	3.249	0.086	6.832	1,423	2.8
Youngstown	5.193	1.979	0.170	7.342	6,592	13.2
Chicago	3.487	3.867	0.241	7.595	10,266	20.5
Total						75.6

1 Worthing, Marion, "Comparative Assembly Costs in the Manufacture of Pig Iron", *Pittsburgh Business Review*, v. VIII., No. 1, January 31, 1938, pp. 21–25, Table 1.

Assembly costs at these locations vary; the importance of each component of the costs is emphasized by the difference of $1.17 in favor of Pittsburgh over Chicago due entirely to Pittsburgh's fortunate position in the center of the finest metallurgical coking coal fields in the country.

Although primarily based upon assembly costs, the growth of these great steel production centers to their present size would not have been possible if outlets for at least a considerable part of their products did not exist fairly close at hand; all the production centers coincide with, or are adjacent to, major centers of steel demand. However, the location of these production centers depends only in part on relative assembly costs and the magnitude of local demand for a particular product; it depends, among other things, on the conformation of the market for each product and for the group of products that may be economically produced together.[13]

For example, hot rolled sheets, cold rolled sheets and tin plate, which are produced at the Gary sheet and tin mills of a subsidiary of United States Steel Corporation with all the attendant economies of large scale production, are products of virtually the same integrated process. Major outlets for hot rolled sheets are Chicago, Detroit, and Indiana with important sources of demand in Iowa, Minnesota, and Ohio; Detroit is the principal market for cold rolled sheets, and Chicago

12 Although Pittsburgh historically was established as a steel producing center before Lake Superior ores and coking coal came into general use, its growth and the maintenance of its dominant position has been based on its economical accessibility to these resources.

13 Committee on Iron and Steel Price Research, National Bureau of Economic Research Conference on Price Research, *Proposals for Research on Prices and Pricing Policies in the Iron and Steel Industry* (1939).

is an important market for tin plate. A similar situation exists at the Irvin Works of this same subsidiary in the Pittsburgh district which rolls the same three products. Ohio and adjacent West Virginia counties, Pittsburgh and Philadelphia are major markets for its hot rolled sheets. Cold rolled sheets are principally shipped to Cleveland, other Ohio centers and Philadelphia. The Irvin Works may also supplement Gary in the Detroit market with hot and cold rolled sheets in periods of peak demand, while Metropolitan New York is the major market for its large ouput of tin plate.

This market structure of groups of products that may economically be produced together accounts in part for production patterns with such apparent inconsistencies as limited capacity at Detroit and excess capacity, as compared to local demand, at Pittsburgh. The effects of historical development and the immobility of steel making equipment will be discussed later.

Birmingham, Alabama, and vicinity is another location with a favorable combination of assembly and production costs. Assembly costs at Birmingham are undoubtedly the lowest in the country—iron ore, coal and flux being in close proximity. In this case low assembly costs compensate in part for the comparatively poor quality of the raw materials; iron content of the ores is low and phosphorous content high, making conditioning and sintering desirable; the coal requires washing before coking. With wage rates lower than other districts, production costs are also economical, although basic wage rates have been rising in the South. These advantages of assembly and production costs are offset by remoteness from major markets; a substantial part of the tin plate produced at the large plant recently erected by Tennessee Coal, Iron & Railroad Company, another subsidiary of United States Steel Corporation, at Fairfield, Alabama, is shipped to the West Coast and Hawaii.

Sparrows Point, Maryland, is strategically located. Based on the use of high grade imported ores, iron ore costs have been estimated [14] to be less at Sparrows Point than at Lake Erie and Pittsburgh area plants, which advantage is offset, in part at least, by higher assembly costs for coal and limestone. Its accessibility to the large markets of the eastern seaboard, and its ability to compete on the West Coast via all-water transportation due to tidewater facilities, make economical distribution costs a major factor in the favorable location of Sparrows Point.

Combined assembly, production and delivery costs make possible integrated steel production on a commercial basis in only one other geographical area at the present time; [15] Colorado and Utah both possess iron ore, fair coking coal and limestone in sufficient quantities and within reasonable assembly distance of each other. Due to prohibitive distribution costs, however, this district must depend, in the main, on local demand for special products. At Pueblo, Colorado, the Colorado Fuel and Iron Corporation, cognizant of this situation, produces principally rails and track accessories for Western roads, and wire products for farm and ranch consumption. At Ironton, Utah, the Columbia Steel Company, a subsidiary of United States Steel Corporation, operates a blast furnace whose pig iron output is taken in part by its West Coast steel mills near Los Angeles and San Francisco and in part by local buyers. California steel mills also use a considerable amount of scrap obtained locally.

Although it is an important steel consuming area, the West Coast cannot support more than limited steel making capacity due to high assembly costs, particularly in the face of competition from Birmingham and Sparrows Point, both of which can serve this area on a more economical basis.

The principal steel producing centers of the nation, therefore, are confined to particular geographical areas where the raw materials for steel making can be economically assembled. Differences in the development and activity of these producing areas have been determined to a considerable extent by the relative costs of transporting steel to consuming areas. Many small non-integrated mills, however, are located outside the major producing areas where they may use local scrap, merchant pig iron or semi-finished steel to produce steel for consumption in the local area or may specialize in particular products to distribute in more widespread markets.

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[14] Maryland State Planning Commission, *The Iron and Steel Industry—Blast Furnaces, Steel Works and Rolling Mills*, November 1938, p. 14.

[15] With the exception of certain areas with small local ore deposits, capable of supporting limited operations, i. e., ore deposits of New Jersey, Eastern Pennsylvania, and the Adirondacks, economically accessible to Pennsylvania coal fields.

TECHNOLOGICAL ASPECTS

Steel making equipment installed at the producing centers is both costly and immobile; the economies of size inherent in steel manufacture have been important factors in determining the design of modern mills. The result is that the small plants of fifty years ago have been succeeded by complex and gigantic operating units.

Twenty years ago the coke used in blast furnaces was principally made in banks of simple beehive ovens, usually located at the mine. Today, it is made at or near the steel plant in long batteries of by-product coke ovens with alternating coking and heating chambers topped by coal larries, off-takes and collecting mains. In close proximity stand the tall cooling towers and scrubbers, the ammonia house and benzol plant used to obtain numerous by-products from the tars and gases emanating from the coking ovens, which are today recovered and put to use.

In 1880 the capacity of the most efficient blast furnace, a comparatively simple unit, was one hundred tons per day; at present the newest and most efficient furnaces are rated at 1100 to 1200 tons per day. This increased output has been accomplished not only by increase in size and better blast furnace practice, but by mechanical improvements and the development of auxiliary equipment. A blast furnace plant today is enormous and complicated. The furnace is a tall circular structure 90 to 100 feet high, built of firebrick and reinforced externally by a close-fitting steel shell. It is provided with apparatus for hoisting iron ore, coke and limestone to the top where they are charged into the furnace. Large pipes carry the gas generated in the furnace to the stoves where it is used for heating purposes. Beside each furnace stand four cylindrical stoves nearly as high as the furnace itself. These stoves heat air to high temperatures before it is blown into the furnace at the rate of five tons of air for every ton of iron produced. The impurities in the raw material are either burned out or accumulated in the slag which gathers on top of the molten metal. This slag is removed through the higher of two tapping holes. Through another tapping hole the molten iron is drawn at periodic intervals either into ladles to be carried to huge containers known as mixers subsequently to be taken to the open hearth and Bessemer converters, or into runners leading to the pig iron casting beds. A boiler house, power plant, pumping station, turbo-blower, stockyard, ore bridge, car dumper and raw material bins, all constitute important parts of blast furnace equipment.

The steel making equipment is equally complex and has increased in size as it has become more efficient. In 1899 the average open hearth furnace had a capacity of 22 tons per heat; in 1938 the average furnace capacity was 95 tons per heat and the largest 400 tons per heat. Even more spectacular has been the radical improvement in design and the increase in size of continuous rolling mills for flat rolled products in recent years. This acceleration of growth has been so dramatic that in 1936 a continuous rolling mill with a capacity of as much as 600,000 tons of finished flat rolled steel per year was unprecedented; yet in March 1938 a continuous strip mill was opened with an annual capacity of approximately one million tons.[16]

Equipment used in each stage of modern steel making is usually so combined as to perform a series of vertically integrated operations; conservation of heat and power requires continuous processes. Assurance of adequate sources of raw material and the elimination of purchasing expenses at each stage of operations are important factors in promoting further integration.

Vertical integration is a dual development in the industry. Non-integrated and semi-integrated producers desiring independence from producers of semi-finished steel and the owners of raw material reserves, and influenced by the possibility of additional savings, integrate toward the sources of their raw materials. Partly as a result of such movement and partly due to the decline in demand for steel used in producers' durable goods industries, producers of semi-finished and heavy steel have obtained outlets for their productive capacity by integration towards more highly finished products.

CAPITAL INVESTMENT REQUIREMENTS

This combination of huge units vertically integrated requires large capital investment. A modern blast furnace of about 1,000 tons capacity with the auxiliary equipment above mentioned costs four to five million dollars. The

[16] Republic Steel Company continuous strip mill, Cuyahoga Valley, Ohio.

average investment required for a modern steel works of efficient size is approximately $100,000,000. Such a mill would be capable of producing about 1,000,000 tons of ingots per annum and would have diversified finishing equipment of sufficient capacity to convert about half the output into billets and other semi-finished steel and the other half into sheets and strip. Such an investment would not include operations prior to the assembly of raw materials at the plant site, i. e., the plant would be integrated only from coke plant to continuous rolling mills. Operating units may be and sometimes are much larger; a single continuous hot and cold rolling finishing plant alone may require an investment of $60,000,000.

Such large and complex equipment cannot be moved in response to geographical shifts in demand, and only extraordinarily great differential advantages of a new location justify scrapping existing facilities embodying large unamortized investment and long remaining service life. New areas of demand usually develop only for particular products or groups of products and it may be more economical for the established producer to install sufficient capacity at the existing location to compete in the new markets than to build integrated steel works at the source of the new demand. This decision may depend first, on the combination of products that can be economically produced together, and second, on whether the steel demanded can be produced by integrating new facilities with unused capacity at the existing location. Modernization and expansion at the established location may be rational; and the development of an individual company at a particular location may thus be perpetuated.

FACTORS IN EXPENDITURES FOR NEW PLANTS AND EQUIPMENT

The number of producers of any particular steel product bears a rather direct relationship to the minimum investment required to become such a producer. It is pertinent to inquire first, the source of the funds for such capital expenditures and second the inducements necessary for the investment of these funds.

Source of Funds.—Funds for investment in new plants and equipment may be obtained from any one or a combination of the following sources: (1) Outside capital; both existing companies and promoters of new companies may borrow through the medium of notes and bonds or sell stock to obtain funds from this source. (2) Accumulated earnings; the availability of this source of funds over the years enabled existing companies to promote and keep pace with the upward trend in national steel consumption, and in addition helped small non-integrated and semi-integrated steel companies grow into large integrated units. (3) Depreciation and other reserves; this has been the primary source of funds for replacement and modernization programs.

Incentives for Investment—Profit Motive.—The normal incentive for investment is prospective profits. This may cause the expansion of existing companies; the development of non-integrated and semi-integrated companies into integrated companies being a case in point; or it may induce new companies to enter the field usually as non-integrated or semi-integrated specialists. The formation of a new integrated steel company, except by merger, would not be likely today since: (1) A large capital investment is necessary. (2) The technological and organizational difficulties in forming such a company are great. (3) The difficulty of obtaining an immediate market for the output of such a new company would be tremendous; great losses in early years would therefore seem inevitable.

Incentives for Investment—Obsolescence.—Obsolescence has been an important motive for capital expenditures by the steel industry in recent years. This has been due to: (1) New production techniques; the introduction of continuous hot strip mills and continuous cold reduction processes has brought about a major technological revolution in the industry. (2) The development of new products; cold reduced sheets and cold reduced tin plate have practically displaced the hot rolled products in major markets. In order to remain in markets demanding the new and better products, companies have had to purchase new equipment and construct new plants. (3) Shifts in demand; e. g., the marked increase in the demand for sheets, strip, tin plate and other steel required by consumer goods industries, and the decline until very recently in the demand for rails, plates and structural shapes. This shift has caused expansion of existing companies both to meet the new demand and to obtain outlets for otherwise unutilized ingot capacities.

SIZE AND NUMBER OF PRODUCERS

The producers of the bulk of tonnage steel are large in size and relatively few in number, which is a natural development in an industry requiring great capital investment as the result of large scale equipment, vertical integration and, in certain cases, horizontal integration. Principal producers (including subsidiaries) and their respective percentages of total ingot capacity for the year 1938 are indicated in the following table:[17]

Percentage Distribution of Capacity Among Producers of Steel Ingots and Steel for Castings—1938

Name of Corporation	*Percentage of Total[1] Annual Capacity*
United States Steel Corporation	35. 3
Bethlehem Steel Corporation	13. 7
Republic Steel Corporation	8. 9
Jones & Laughlin Steel Corporation	5. 0
National Steel Corporation	4. 7
Youngstown Sheet & Tube Company	4. 3
Inland Steel Company	3. 9
American Rolling Mill Company	3. 6
Wheeling Steel Corporation	2. 4
Other smaller companies	18. 2
Total	100. 0

[1] This total does not include those companies that produce steel only for castings.

However, ingot capacities should not be the sole criteria of the size and number of producers, especially in the consideration of markets for particular products, since the number of companies and the percentage of the total that each has capacity to produce varies with individual steel products. The number is determined by: (1) The minimum investment required in equipment to produce the product, the prospective return thereon, and the relative simplicity of the operation. The investment formerly required for a steel mill and past profit margins must be considered in a study of any particular company, since most of the present producers entered the market under conditions different from those which today would face a newcomer. (2) The technological history of the product and the equipment used to produce it. (3) The nature of the demand for the product; its diversity and geographical distribution. (4) The historical development of the producers.

The percentage of the total represented by the capacity of any individual producer is principally a reflection of: (1) The historical development of that producer, particularly with reference to product specialization; (2) The technological history of the product and the equipment used to produce it; (3) The producer's location with respect to demand.

Under the influence of these factors there are distinct variations in the character and total number of producers of each steel product, and in the percentage of total capacity possessed by each producer for each product, and in the geographical distribution of their plants.

CHANNELS OF DISTRIBUTION

Approximately 80 percent of the steel produced by the steel industry is sold directly to consuming industries through the sales organizations of the producing companies so that in the majority of cases "sellers" and "producers" are interchangeable terms in the market for steel.

Jobbers and Warehouses.—The balance of the steel sold passes through the hands of jobbers, warehouses and other distributors which are essential in the sale of standardized products in small lots to widely scattered consumers, or where geographical conditions such as exist on the West Coast make this form of distribution particularly economical.

[17] American Iron and Steel Institute, *Iron and Steel Works Directory of the United States and Canada, 1938*, pp. 401–402.

Although the jobber market is an important factor in the distribution of steel, the influence of this form of distribution on the pricing and marketing of the majority of steel products is negligible. Jobber outlets are, however, important elements in the marketing of galvanized sheets, concrete reinforcing bars, standard pipe, tubes, and merchant wire products.

Importance of Outlets.—Maintenance of outlets for semi-finished and finished steel is important for most members of the steel industry. The acquisitions of such outlets, by integrated producers, which occur from time to time, involve a change in the distribution pattern of the industry.

SUMMARY

The supply side of the steel market from a long term viewpoint is marked by these characteristics: (1) The areas of production are geographically concentrated in a few districts because of location of raw materials and transportation costs. (2) Large size equipment and vertical integration are typical of the industry; some companies are also horizontally integrated, while a number of semi-integrated or non-integrated companies are specialists in particular products. (3) Large capital investment is necessary; however, for certain products the investment necessary to become a producer is relatively much smaller than for others, and this seems to be an important controlling factor in determining the number of producers of a given product. (4) Generally speaking, producers are large in size and few in number, although in particular cases major producers of specialty products may be smaller non-integrated or semi-integrated units. (5) Investment in new plants and equipment arises both in response to prospective profits and as a result of obsolescence.

In contrast with many types of markets the steel market is one not easily entered by producers, or withdrawn from, once entry has been accomplished. The large investment required, technological and organizational difficulties, and the problem of obtaining an immediate market are obstacles to entry. The non-recoverable costs that must be sunk in a steel company are not conducive to withdrawal if there is an opportunity for any return in excess of out-of-pocket expenses.

In much the same manner, the supply side of the steel market differs from other markets in that productive capacity cannot be easily adjusted to meet changing market conditions. Once capacity is installed, it is inelastic and cannot be removed except by scrapping, which ordinarily does not appear desirable due to the large investment involved; nor can capacity be easily expanded except by heavy capital expenditures requiring a considerable time interval.

Characteristics of Cost in the Industry

"OVERHEAD" OR "FIXED" COSTS

There are certain costs in the steel industry which are approximately the same regardless of the amount of steel produced.[18] These costs are sometimes known as "overhead" or "fixed" costs. In the case of the United States Steel Corporation and its subsidiaries such "fixed" costs are composed of the following elements in the approximate percentages indicated:

United States Steel Corporation & Subsidiaries Components of "Fixed" Costs, under 1938 Conditions

Item	Approximate Percentage
Interest	4.56
Pensions	4.23
Taxes (other than social security and Federal income)	13.29
Depreciation and Depletion	16.20
Payroll	34.10
Social Security Taxes	1.37
Goods and Services Purchased from Others	26.25
Total	100.00

[18] This presumes a company in operation. Complete shutdown naturally would decrease these costs sharply.

Other steel producers may have different percentages for the components of their "fixed" costs depending on the degree of integration and their capital structure. However, regardless of their composition, such costs are relatively large for major producers in the steel industry, and with low operating rates are a substantial percentage of total costs.[19]

"ADDITIONAL" COSTS

The costs over and above "fixed" costs represent the "additional" cost incidental to the production of each additional ton of steel, assuming the steel mill is already in operation. Recent studies of the experience of the United States Steel Corporation and its subsidiaries over the past ten years indicate that the addition to the total costs arising from the production of each additional ton[20] of steel is the same regardless of the operating rate at which the additional output is obtained as long as the other factors affecting costs remain constant. This phenomenon of constant "additional" costs covers an observable range of output which extends from around twenty percent of capacity to slightly beyond ninety percent of the physical limit of output. It is not certain that this relationship would hold true as the physical limit of capacity is reached since at that point the equipment may become overtaxed and for various reasons operate less efficiently and at greater cost. Less efficient reserve units may also be placed in service to meet the peak levels. In those circumstances the additional costs incidental to the production of an additional unit of output would cease to be constant and would probably rise sharply. The percentage composition of these costs in the case of the United States Steel Corporation and its subsidiaries is indicated in the following table.

United States Steel Corporation & Subsidiaries Components of "Additional" Costs, under 1938 Conditions

	Approximat Percentage
Taxes (other than social security and Federal income)	2. 57
Depreciation and Depletion	4. 25
Payroll	52. 22
Social Security Taxes	2. 08
Goods and Services Purchased from Others	38. 88
Total	100. 00

For companies less integrated than the United States Steel Corporation and its subsidiaries the percentage attributable to "Goods and Services Purchased from Others" would increase and the percentage of other components decrease.

AVERAGE COSTS

Since the average cost of producing a given ton of steel is the sum of the "additional" costs plus an amount equal to the "fixed" costs divided by the number of units produced, this "average" cost must necessarily be higher than the

[19] See the following table:

United States Steel Corporation & Subsidiaries Percentage of "Fixed" to Total Costs at Various Rates of Operation, under 1938 Conditions

Operating Rate	Percentage of "Fixed" to Total Costs	Operating Rate	Percentage of "Fixed" to Total Costs
10	57. 2	60	22. 9
20	43. 9	70	20. 4
30	35. 8	80	18. 5
40	30. 1	90	16. 8
50	26. 0	100	15. 4

[20] The tons mentioned in describing the cost pattern are weighted tons. This means that each ton of Rolled and Finished steel product or of other tonnage product which is of a type whose average cost is less than the average cost of all Rolled and Finished steel products, is made to count as less than a full ton while tons of products of a class which is on the average more costly than the average cost of Rolled and Finished steel products, are made to count more than a full ton. In this way the number of tons of all tonnage products shipped has been converted into equivalent tons of average-cost Rolled and Finished steel products. The result is that total costs of various tonnages shipped are made comparable where they would not be if unweighted tonnages had been used.

"additional" cost for nearly the whole range of operations almost to the limits of capacity.[21]

The components of the average cost of producing a ton of steel are, to a certain degree, largely outside the control of steel producers; wage rates tend to be inflexible and lag in adjustment, prices paid for goods and services are often fixed by outside agencies as they are in the case of railroad rates, interest is determined by factors in the money market, taxes are established by law, and depreciation and depletion charges cannot long be disregarded.

The Dynamics of the Market for Steel

COSTS AND DEMAND

The inelasticity of the total demand for steel and the aforementioned characteristics of cost in the steel industry place definite limitations on the financial ability of the industry to increase production by decreasing prices. Assuming that each 1 percent decrease in price would increase consumption of steel 1 percent, a 10 percent decrease in the average level of steel prices prevailing during 1938 even though offset by a 10 percent increase in the quantity of steel sold, would have increased the deficit[22] of the United States Steel Corporation from $8,758,572.00 to $52,058,572.00. This estimate is most conservative, since there is every indication that the elasticity of the demand for steel is not as great as assumed above.

Despite this overall price-volume-cost relationship in the industry, the potential elasticity of demand for the product of an individual steel company and the internal problems arising within individual companies from this characteristic cost pattern further affect the market for steel.

Except in periods of high operations, and more particularly in times of slack demand, there is a tendency to cut prices below average costs so long as the price for the additional unit sold is above the "additional" cost necessary to produce such additional ton of steel. The large size of individual orders and the potential shiftability of buyers of steel in response to price considerations accentuate such a tendency, particularly when, due to the inelastic nature of the total demand for steel, the problem for the individual producer is to obtain a share of the going business. Thus it is that in periods of restricted demand, knowing that anything above his "additional" costs contributes something toward "overhead" or "fixed" costs which must be met in any event, the producer will cut prices below his average costs if he feels he can obtain additional business for his mills thereby. This inherent tendency to cut prices, however, is offset to some extent by the knowledge that competitors will meet price concessions as soon as they become known.

PSYCHOLOGICAL FACTORS

Buyers and sellers of steel react differently at various stages of the business cycle; this is natural in an industry marked by large cyclical fluctuations in the demand for its products. In depression the tendency toward price cutting grows as buyers bargain more sharply and sellers scramble for what business there is in an effort to reduce deficits mounting under the burden of "overhead" or "fixed" costs. In better times buyers are less averse to paying higher prices, and sellers no longer under the goad of operating losses are reluctant to make price concessions. Therefore, in part at least, cyclical fluctuations in steel prices are attributable to changes in the psychology of buyers and sellers.

CHARACTERISTIC PATTERNS OF ACTION BY SELLERS IN THE MARKET FOR STEEL

The factors mentioned above have resulted in phenomena that reappear each time the steel industry passes through a full cycle in demand.[23] In a rising cycle

[21] In the case of United States Steel Corporation and its subsidiaries, the average cost of all operations per ton of steel shipped, under 1938 conditions, would be $55.73, plus an amount equal to $182,100,000 (the total "fixed" costs) divided by the number of tons produced.

[22] Deficit after deduction of bond interest, but before Federal income and profit taxes and exclusive of non-operating income and expense.

[23] The pattern outlined has perhaps been oversimplified since (1) all products do not pass through each phase of the cycle simultaneously, making the pattern more confused than it appears in this outline; (2) the existence of jobbers and distributors complicates the situation with respect to certain products; (3) in addition, the homan factor is unpredictable, making it difficult for businessmen always to rationalize their actions as they participate in a highly competitive market.

as demand increases, average costs in the industry decrease as additional units are produced, but these decreases are usually soon offset by higher raw material prices, and increased labor and other costs. In addition, as already indicated, the psychology of the buyers and sellers changes and the industry may feel that the time is propitious for an increase in prices, not only to cover increased costs, but also to compensate for past losses and to accumulate resources for possible future periods of depression. Quite naturally, however, producers of steel do not care to take the risk of losing their share of business by an increase in prices which may not be followed by their competitors.[24] The natural result is that the industry is inclined to wait for some large producer to announce higher prices. This natural phenomenon in the rising cycle is sometimes called "price leadership". So long as the term is used to describe a natural phenomenon resulting from factors inherent in the industry and involving no collusion or other violation of the anti-trust laws, there is little objection to the term.

In the falling cycle, average costs increase as demand and production decrease, accentuated in part by the continuance of high wages which have a tendency to become inflexible, or in any event to lag in their adjustment to the lower level of production. In the early stages of the decline in demand, the industry, aware of the inflexibility of the total demand for steel and faced by rising average costs per unit of output, naturally is averse to cutting prices when the prices they are getting on the going business barely cover their costs. From past experience the industry is aware that any weakening of prices leads buyers to hold off purchasing in the expectation that prices will go still lower. Then too, the steel producer may be optimistic about an improvement in general business conditions in the near future. However, sporadic price cutting soon breaks out spurred by the individual producer's hope of obtaining an additional share of the going business. Concessions soon become general knowledge in the trade; and while, for a period, some producers may not care to compete on the basis of these concessions, eventually all producers must meet competition at the going prices.

The Basing Point Method of Quoting Delivered Prices

The basing point method of quoting delivered prices in the steel industry has developed over a long period of years in response to the fundamental economic factors of that industry. Two authorities on the economics of the steel industry succintly point to the basic fallacy in the reasoning of most critics of this pricing method when they state that "Intelligent appreciation of the pricing problem in the steel industry has suffered from a failure of most commentators to distinguish between the basing point system as a medium or mere mechanism for the translation of policy into action and the economic roots of that primary policy itself."[25]

ECONOMIC ROOTS OF THE BASING POINT METHOD

In quoting prices manufacturers of steel must take certain basic factors into consideration: (1) The cost of transportation from steel mill to destination may be substantial in relation to the value of steel shipped. Consumers of steel are interested in the cost of steel at the place where they use it. Therefore, most consumers want to know the lowest delivered price at which they may purchase the steel they require. (2) Consumers of steel are located in different parts of the country and although more steel may be sold in some sections than in others, even major markets for the same steel product may be geographically widespread. (3) Producers of steel must locate their plants at points where raw materials may be economically assembled. This confines major steel producing centers to a few geographical areas. Modern steel making equipment is large and complex; it requires great capital investment and is extremely immobile once installed. (4) To insure economical and reasonably stable operations, steel producers must sell large quantities of steel and since consumers of the group of steel products that may economically be produced together may be located in different areas, the producer must be able to quote prices at diversified locations. The extent

[24] Does not apply where all capacity of a particular product is booked substantially ahead.

[25] de Chazeau and Stratton, *Economics of the Iron and Steel Industry*, by Daugherty, de Chazeau and Stratton, p. 578 (McGraw-Hill Book Company, 1937).

to which he may economically serve different consuming areas will be determined by the most economical combination of assembly costs of raw materials, production costs and the cost of delivering finished steel to important markets. (5) Producers of steel have large "fixed" costs, which must be met regardless of the number of tons produced so long as operations are continued. Although these producers realize that the total quantity of steel consumed cannot be greatly influenced by reductions in steel prices, they do know that the quotation of a delivered price only slightly below other quoted delivered prices may influence the placement of substantial orders with a particular producer. Since competition for available business is keen, and particularly so when low rates of operation make the "fixed" costs burdensome, a knowledge of the level at which competition must be met in quoting prices at a definite location is valuable in preventing completely disorganized markets that might prove disastrous to the industry.

The multiple basing point method of quoting delivered steel prices is a simple pricing medium which has evolved over a long period of time to meet the peculiar characteristics of the steel industry. It is an open price method of quoting delivered prices at diversified locations. Such open prices are similar to list prices which may be and are reduced to meet competition. As a pricing medium it permits the consumer to bargain with a number of producers for both steel and service at the lowest possible price and at the point where he needs it. It serves producers by permitting them to compete in diversified markets to obtain the volume and even flow of orders necessary to economical operations. In essence, it provides an orderly medium by means of which consumers and producers of steel may trade to their mutual benefit.

Relation of Competition to Profits, Capacity and Costs of Distribution

Price competition is necessary in any industry operating in a capitalistic system. Is the steel industry competitive? Efforts at such determination too easily lead into the realms of economic sophistry. Criticism and defense of competition in the industry should not be based on abstract criteria which fail to take into account the fundamental phenomena involved; it should be based on tangible evidence.

Edward Chamberlin in his notable work, "The Theory of Monopolistic Competition", demonstrates that evidence of imperfect functioning of competition may be found in any one, or a combination of three, undesirable elements.[26] The first is excessive profits resulting from high monopoly prices. The second is excessive productive capacity induced by high prices which encourage the entrance of producers into the market, until the reduced volume of each lowers profits to the minimum level, although the original high prices remain. The third is excessive selling costs which contribute to higher prices if selling costs per unit are greater than the decrease in production costs resulting from the increased volume of production. Selling costs are simply one element of distribution costs, and Mr. Chamberlin, although he does not do so, could apply his thesis to all distribution costs with equal force. Assuming that excessive profits, excessive capacity and/or excessive costs of distribution are criteria of the lack of competition, what is the position of the steel industry with respect to these standards?

PROFITS

Profits in the steel industry are not excessive. From 1919–1928 inclusive, the average return on investment was 5.1 percent; from 1929–1938 the average rate of return was 2.4 percent.[27]

A study based on a composite of financial statements of leading companies in their respective industries illustrates the comparative earnings of other industries and the steel industry for the period from 1929 to 1937 inclusive.

[26] Chamberlin, Edward, *The Theory of Monopolistic Competition*, Chapters V and VI, Harvard University Press, 1938.

[27] *Steel Facts*, August 1939, No. 35, p. 3. Since the years, components and sources are different this figure naturally does not agree with that for "Iron and Steel" in the table which follows.

Ratio of Earnings to Net Assets—1929–37 Inclusive (Earnings Before Interest in Percent of Total Assets Less Current Liabilities) Steel Industry Compared With Other Industries

Industry:	Earning Ratio	Industry—Continued.	Earning Ratio
Tobacco and Products	12. 3	Motion Pictures	5. 6
Automobiles and Trucks	11. 7	Building and Real Estate	5. 2
Household Products	10. 6	Telephone & Telegraph	5. 0
Office Equipment	10. 3	Paper and Products	4. 9
Automobile Accessories	10. 2	Oil Producing and Refining	4. 8
Chemicals and Fertilizers	10. 1	Metals (Non-Ferrous)	3. 8
Leather and Shoes	9. 3	Rubber & Automobile Tires	3. 7
Retail Trade	9. 0	Railroads (Class I)	3. 6
Electrical Equipment & Radio	7. 6	Railroad Equipment	3. 1
Food Products	7. 6	Steel and Iron	2. 0
Public Utilities	6. 0	Textiles & Apparel	1. 5
Machinery (Industrial & Agricultural)	5. 7	Coal	1. 1

Sources: Standard Trade and Securities, Standard Statistics Company, Vol. 31 #20 Section 3 for 1927—1935, Vol. 89 #15 Section 5 for 1936 and 1937.

On the basis of these figures the steel industry can hardly be accused of excessive profits. Are these low profits caused by excessive capacity?

CAPACITY

Capacity of the steel industry is not excessive. Unused or idle capacity should not be confused with "excess" capacity. Past experience indicates that even in periods of peak demand orders are not distributed among products in such a way as to make possible full utilization of all facilities. In practice, therefore, operations probably would never be maintained at 100 percent of finished steel capacity because of lack of coordination between demand and capacity for various products. Production might, therefore, be expected to run five or ten percent, or even more, below capacity at the peak of the cycle.

In times of real emergency, or under the tremendous pressure of excessive demands on the industry, it might be possible, by bringing into operation obsolete facilities, lengthening the work week, eliminating holidays, and by other means, to attain an operating rate in excess of 100 percent. This last happened in May 1929.

True, the steel industry had a large amount of unused capacity during recent depression years, but this is reasonable and to be expected in an industry with capacities that are rigid and immobile and whose rate of operations is so controlled by the tremendous cyclical fluctuations in the demand for steel. If the industry is to have facilities to supply the peak or near-peak demand, it must have idle capacity during the periods of lower demand. An industry which, in the partial recovery of 1937, produced steel ingots for three successive months in an amount roughly equivalent to the average monthly capacity for the industry in the high production year of 1929, cannot have "excessive" capacity if it is to take care of the demands of a normal recovery which would only have to be about 10 percent greater than the peak months of 1937 to utilize the present full capacity of the industry. The vital importance of existing capacity is emphasized by current conditions which make it imperative for the steel industry to produce steel in quantities never before equaled in its history. Quite conceivably, with any capacity less than it presently possesses, the steel industry would become a bottleneck and prevent full normal recovery.

DISTRIBUTION COSTS

The steel industry does not have excessive distribution costs. In a study of distribution costs of 312 manufacturers in 1931 [28] "Iron and Steel and Their Products," a very broad classification, ranked among those having the lowest distribution costs. The steel industry proper undoubtedly had even lower distribution costs than those companies included in the classification "Iron and Steel and Their Products," if the records of the United States Steel Corporation and its subsidiaries are in any way indicative of the average distribution costs for the steel industry.

Selling Expense.—The major elements in the distribution cost study referred to are "direct selling costs" and "advertising and promotion costs." These two items combined represented 11 percent of net sales of those companies reported as component manufacturers of "Iron and Steel and Their Products"; in 1931, the same year used in the aforementioned study, direct selling costs and advertising and promotion costs were 3.1 percent of net sales for the United States Steel Corporation and its subsidiaries.[29]

Freight Absorption.—An element more or less peculiar to the steel industry is the amount paid by a steel producer for the transportation of steel from the steel mill to the customer over and above the amount of the freight charge included in his computation of the delivered price under the basing point method of quoting delivered prices. This results from competition in the steel industry, as a producer in order to share in the business must meet the delivered price of a competitor whose steel mill is nearer freight-wise to the customer. This is sometimes called "freight absorption" by critics of the basing point practice.

A broad sampling [30] of shipments for the month of February 1939 by the American Steel & Wire Company, Carnegie-Illinois Steel Corporation and Tennessee Coal, Iron and Railroad Company, three subsidiaries of the United States Steel Corporation, showed average "freight absorption" of $1.99 per ton equivalent to 3.75 percent of the net sales return to the companies on these shipments, and 3.6 percent of their delivered value to the customer.[31] In view of the fact that "freight absorption" *plus* selling expenses and advertising and promotion costs for the steel industry are less than just the selling expenses and

[28] See the following table:

Distribution Costs of 312 Manufacturers, 1931

[In Per Cent of Net Sales]

Product	Percent	Product	Percent
Consumer Products:		Consumer Products—Continued.	
Drugs and Toilet articles	48.8	Agricultural Supplies	18.4
Paints & Varnishes	38.6	Tobacco Products	18.3
Furniture	33.1	Sporting Goods	18.2
Heating Equipment	32.9	Radio Equipment	16.5
Office Equipment & Supplies	32.2	Industrial Products:	
Confections and Bottled Beverages	31.6	Machinery and Tools	25.8
		Building Materials	23.7
Petroleum Products	31.0	Stone, Clay and Glass	21.7
Jewelry and Silverware	28.7	Paper Products	20.4
Grocery Products	27.1	Chemicals and Allied Products	19.9
Household Appliances	26.5	Electrical Equipment	19.7
Automotive	24.7	Iron and Steel & Their Products	19.0
Clothing	22.6	Nonferrous Metals	18.5
Home Furnishings	21.7	Transportation Equipment	15.5
Shoes	21.2	Textiles	9.2
Hardware	18.9		

An Analysis of the Distribution Costs of 312 Manufacturers, Association of National Advertisers and the National Association of Cost Accountants, New York, 1933, pp. 64, 106.

[29] Percentage of selling expenses and advertising and promotion costs to net sales for the United States Steel Corporation for 1926 is 1.34%; for 1927, 1.65%; for 1928, 1.61%; for 1929, 1.53%; for 1930, 2.29%; for 1931, 3.07%; for 1932, 4.32%; for 1933, 3.22%; for 1934, 3.32%; for 1935, 2.79%; for 1936, 2.27%; and for 1937, 1.98%.

[30] Temporary National Economic Committee, Form B. Distribution and Pricing of Selected Steel Products for month of February 1939.

[31] "Adjusted" freight absorption, i. e., the above mentioned unadjusted freight absorption less basing point price differentials, averaged $1.33 per ton, equivalent to 2.4% of the delivered value for the above named subsidiary companies. Data based on Form B returns for the 55 steel companies reporting show that "unadjusted" freight absorption for those companies averaged $1.77 per ton, or 3.2% of delivered value, and "adjusted" freight absorption averaged $1.16 per ton, or 2.1% of delivered value. (See T. N. E. C. Exhibit No. 1409, Charts C27, C28 and C31.)

advertising and promotion costs of nearly every other industry,[32] it cannot be charged that distribution costs in the steel industry are excessive.

Since excessive profits, capacity and distribution costs are not present in the steel industry, it may reasonably be concluded that, although the economic factors in the steel industry are such that it cannot survive for long under conditions of cut-throat competition, it is sufficiently competitive to be free of the alleged evils of lack of competition.

CONCLUSION

THE FUNCTION OF THE STEEL INDUSTRY IN THE NATIONAL ECONOMY

There remains one question of vital interest. Does the steel industry perform its proper function in the national economy?

As a Source of Raw Material.—The steel industry primarily supplies a basic raw material for the production of other goods and services. Properly to perform its function it must continuously provide material meeting the exacting and changing demands of a great variety of industries each of which has diversified requirements. The steel industry has consistently done so, as is clearly evidenced by the industrial growth of the United States. The steel industry has developed new products and improved the old ones, both on its own initiative and in close cooperation with the steel consuming industries. In fact, if it were not for the steel industry, many of the major improvements in products of other industries would not have been possible. For example, the streamlined all-steel automobile would have been impossible to construct fifteen years ago since it depends upon the deep drawing qualities and strength of the modern cold rolled sheets. Due primarily to the recently introduced cold reduced tin plate certain fruits and vegetables are now available throughout the year as canned products. Beer could not be sold in cans so readily if the steel industry had not developed a special type of tin plate which can withstand internal pressure. New streamlined trains use high tensile, low alloy steels and stainless steels which have been developed by the steel industry. Special heat treatments have been discovered which, when applied to rails, insure better and longer service.

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[32] See the following table:

Selling Expenses and Advertising and Promotion Costs of 312 Manufacturers in 1931

[In Per Cent of Net Sales]

Product	Direct Selling Costs	Advertising & Promotion	Total
Consumer Products:			
Drugs and Toilet Articles	11.3	18.4	29.7
Paints and Varnishes	17.1	7.5	24.6
Furniture	14.8	6.1	20.9
Heating Equipment	15.8	7.9	23.7
Office Equipment and Supplies	21.3	3.2	24.5
Confections and Bottled Beverages	11.5	6.7	18.2
Petroleum Products	10.9	6.0	16.9
Jewelry and Silverware	11.5	6.3	17.8
Grocery Products	11.1	6.2	17.3
Household Appliances	12.8	6.8	19.6
Automotive	12.9	4.0	16.9
Clothing	11.2	3.7	14.9
Home Furnishings	12.4	2.9	15.3
Shoes	8.7	3.7	12.4
Hardware	9.1	2.2	11.3
Agricultural Supplies	8.2	1.6	9.8
Tobacco Products	3.2	8.2	11.4
Sporting Goods	8.4	3.6	12.0
Radio Equipment	5.4	5.3	10.7
Industrial Products:			
Machinery and Tools	14.6	4.4	19.0
Building Materials	11.8	3.0	14.8
Stone, Clay and Glass	10.0	3.1	13.1
Paper Products	9.4	2.5	11.9
Chemicals and Allied Products	10.6	1.2	11.8
Electrical Equipment	12.0	3.0	15.0
Iron and Steel and Their Products	9.0	2.0	11.0
Nonferrous Metals	10.2	1.1	11.3
Transportation Equipment	8.8	1.7	10.5
Textiles	5.1	1.3	6.4

An Analysis of the Distribution Costs of 312 Manufacturers, Associations of National Advertiser and the National Association of Cost Accountants, New York, 1933, pp. 64. 160.

To produce these better products and still keep costs down, the steel industry over the years has constantly improved its equipment and has developed entirely new equipment such as the continuous sheet and strip mills which so recently revolutionized the industry. It cannot be said that the steel industry has been remiss in providing better materials to be used by other industries to make products and provide services. This functioning of the steel industry to supply new and better steels is particularly germane to the pricing problem since quality improvements are usually not reflected in price series. In addition, many types of steel which are in actuality new products may be known by the names orginally applied to the products they replaced and as a result the new products and the old may be included in single price series although they may have little or no homogeneity.

As a Factor in Employment.—Steel prices would be even more important to the national economy if they influenced the amount of goods that could be sold by companies for which the steel industry is a source of supply, and so affected the rate of employment in those industries. This study has indicated that the price of steel is of negligible importance as a factor in the demand for goods made of steel because of the small percentage of the cost of the steel as related to the cost of the finished product. Steel prices have little effect on national production or employment. This is not to imply that the steel industry may charge any price its whim or fancy may dictate. Competition among producers, and bargain-driving purchasers with large orders to place, keeps prices at levels which sometimes do not even cover costs.

It has been charged by some that steel prices have remained firm in the face of falling demand, and as a direct result production and pay rolls have declined drastically. If the implications of this charge could be sustained it would be a serious indictment. But they cannot be sustained. This study has shown that the demand for steel is derived from the demand for goods made of steel. This demand depends in turn on such factors as the level of national income and confidence that in the future there will be opportunity for the profitable use of additional durable goods. The total demand for steel is inelastic; that is, the total quantity of steel bought from the industry would not be substantially different at any particular time if the price were higher or lower. The steel industry must have orders on hand before it can produce; steel is made to exacting specifications for particular uses; the very bulkiness of such steel items as might be made in anticipation of future demand prevents their heavy production for inventory. If there is lack of confidence in the future and declining national income, production and consequently hours of employment, will decrease despite all efforts of steel producers. Only confidence in the future and actual or anticipated increase in national income can create production and resultant employment in the steel industry.

Despite the negligible influence of price on demand for steel, and waiving the fact that the composite published price of steel is more flexible than critics often suppose, and the further fact that net yields received by the industry are more flexible than indicated by published figures,[33] what adjustments would have to be made if steel prices were cut appreciably? Since substantial "fixed" costs must be met regardless of the amount of steel produced, prices cannot be out of line with total costs over any considerable period.

What costs could be adjusted if prices were substantially reduced when the industry was operating at 50 percent of capacity? Based on cost data of the United States Steel Corporation and its subsidiaries previously discussed, payrolls would be approximately 50 percent of total costs at that rate of operation; goods and services purchased from others, 34 percent; taxes and depreciation and

[33] See the following table:

Indexes of Prices
[1926=100]

Year	Composite Iron Age Prices	U. S. S. C. Mill Net Yields	Year	Composite Iron Age Prices	U. S. S. C. Mill Net Yields
1926	100.0	100.0	1933	81.2	76.7
1927	95.1	96.5	1934	87.8	89.1
1928	93.5	93.3	1935	88.9	90.9
1929	95.4	94.5	1936	89.7	88.6
1930	88.5	87.9	1937	106.4	99.6
1931	84.5	81.3	1938	103.4	99.8
1932	82.1	78.8			

depletion about 7 percent each; and the remaining 2 percent of total costs would represent interest to bondholders and pensions to retired workers. There is no getting away from taxes; they must be paid. Depreciation and depletion charges could be overlooked for short periods, but not for long. If interest were not paid, the Company would be forced into bankruptcy. The remaining 84 percent of total costs represents payrolls and goods and services purchased from others. Goods and services purchased from others perhaps could be obtained at lower prices by sharp bargaining where the prices are not fixed by law as they are in the case of railroad rates. Payrolls remain. They are 50 percent of total costs. There is very little doubt that any appreciable cut in steel prices over the long run would have to be met by reducing wage rates.

As a Factor in the Growth of the Nation.—This study has discussed the productive capacity of the steel industry and indicated the reasons why unused capacity may be present in certain periods, but excess capacity, in the sense that it is not necessary to the economic well-being of the industry and of the nation, is absent. It has been shown that assembly costs of raw materials, the geographical location of markets for products that may be economically produced together, the immobility of steel-making equipment, the huge investment required therein, and the historical development of individual companies are more important than the pricing method in accounting for the existence of more capacity in certain districts than local consumption might seem to dictate. It has been pointed out that steel-making capacity has developed in every area where raw material assembly costs, costs of production and nearness to consuming markets have been conducive to such development. On these bases it cannot be contended that the price structure of the steel industry has been instrumental in the preservation of uneconomic capacity nor in the prevention of the expansion of economic capacity.

In brief, the steel industry has efficiently performed its function in the national economy, has materially assisted in the development of this country, and has ever been prepared to meet the needs of the nation in each forward surge of prosperity as well as in times of national emergency.

Exhibit No. 1411

A STATISTICAL ANALYSIS OF THE DEMAND FOR STEEL, 1919–1938

This is an analysis prepared by the Special Economic Research Section of United States Steel Corporation, composed of Messrs. Edward T. Dickinson, Jr., Ernest M. Doblin, H. Gregg Lewis, Jacob L. Mosak, Mandal R. Segal, Dwight B. Yntema and Miss Marion W. Worthing. The work of this group was under the supervision of Theodore O. Yntema, Professor of Statistics, University of Chicago. This analysis was written by H. Gregg Lewis who had the benefit of suggestions from other members of the staff. It is issued by United States Steel Corporation.

November 1, 1939.

CONTENTS

I. Statement of the Problem

This analysis[1] undertakes to measure the importance of the level of steel prices in determining the quantity of steel[2] sold. More specifically the question to be considered in this study is:

> If the average level of steel prices in any year had been higher or lower than it actually was by a certain percentage, but every-

[1] No attempt will be made in this paper to summarize or criticize previous statistical studies of the demand for steel, except as this study does so by implication. However, the following reports should be consulted in connection with this paper: Henry L. Moore, *Economic Cycles: Their Law and Cause* (New York, 1914); Roswell H. Whitman, "Statistical Investigations in the Demand for Iron and Steel", Ph. D. dissertation, University of Chicago, 1933; National Resources Committee, Industrial Committee, *Patterns of Resource Use* (Preliminary Edition for Technical Criticism); (Washington, 1939), pp. 63, 65, 128–129, 131–132.

[2] Throughout this paper the term *steel* should be understood to include only those products sold by the steel production industry—i. e., what is generally understood as the steel-works and rolling mills industry—to consumers outside that industry. The term *products-made-from-steel* includes all products into which steel so defined enters as a raw material of production.

thing else had been the same,[3] by what percentage and in what direction would the quantity of steel sold in that year have changed? In other words, what is the *price elasticity of demand for steel?*

II. Summary of Conclusions

The analysis of the following pages indicates that in the period 1919 to 1938, year to year fluctuations in the quantity of steel sold are accounted for in major part by changes in economic factors other than the price of steel. Only a very small part of the changes in steel sales can be attributed to steel price changes.[4]

The statistical analysis indicates, although not entirely conclusively, that the demand for steel is very inelastic, i.e., that changes in the level of steel prices (other conditions of steel demand remaining the same) cause much smaller percentage changes in the opposite direction in the quantity of steel sold.[5] The best estimate of the elasticity of demand for steel indicated by this analysis is approximately .3 or .4.

This means that very large reductions in price would be necessary to effect significant increases in the volume of sales. Such price reductions would decrease the gross income of the steel producers, while at the same time increasing their total costs of production.

The major factors affecting the demand for steel, such as consumers' income, industrial profits and business anticipations, seldom remain constant. In the period 1919–1938 fluctuations in these and other factors were of such great magnitude and importance that it would have been impractical to attempt to maintain the level of steel production by compensatory changes in steel prices.

III. Some General Considerations on the Demand for Steel

It may seem that the economic and statistical problems involved in an econometric analysis of the demand for steel are simple. The demand for no other product, however, is more complex, or presents greater analytical problems.

A. STEEL IS NOT A HOMOGENEOUS COMMODITY

The steel industry is generally pictured as a mass-production industry, selling only a few types of steel products, a pound of which is like every other pound of the same type in physico-chemical composition, degree of processing or fabrication, general shape and dimensions.

Actually, the steel industry produces thousands of steel products, most of which are practically made-to-order to the chemical, physical, shape, and dimension specifications of each buyer.[6] And each of the many steel products has its own price.

It is obvious that a demand analysis cannot reasonably be made for each of these innumerable steel products. Thus, one is confronted at the outset with the problem of combining all steel products into a composite whose quantity and price can be measured.[7]

B. STEEL IS A RAW MATERIAL, A PRODUCERS', NOT A CONSUMERS', GOOD

Steel as it is sold by the steel producers usually is *not* a finished product ready for use (consumption) by the ultimate consuming public. It is a raw material used by its buyers, along with labor, machines, and other raw materials in the production of products-made-from-steel.[8]

Thus the demand for steel does not depend solely and directly upon the conditions determining consumers' purchases—but is indirectly derived from the conditions affecting the output of products-made-from-steel.

[3] Except to the extent that changes in other factors affecting the demand for steel are caused by the change in the level of steel prices.

[4] See Section VIII, pp. 25–28. In the years 1919–1938 changes in the level of steel prices were generally of smaller relative magnitude than changes in other factors affecting the demand for steel. It is obvious that large price changes have greater effects than small price changes. But the effects of the changes in steel prices were so small in the period studied as to afford no basis for the inference that considerably greater price changes would have been more than a minor influence in determining the volume of steel produced and sold.

[5] See Section VIII, pp. 27–28.

[6] See, for example, the list of steel products in the *Census of Manufacturers*, 1929 (United States Department of Commerce, Bureau of the Census, 1933), pp. 953–958. Each type listed is composed of many different steel products sharing only the common characteristics of the type. See also the list of steel products for which prices are published weekly in the steel trade journal, *The Iron Age*.

[7] See pp. 41–49 for a further discussion of this problem.

[8] See p. 1, *footnote* 2 above for a definition of *steel* and *products-made-from-steel*.

This complicates the analysis because the amount of steel sold to a producer of products-made-from-steel depends largely on:

(1) His current and expected output of products-made-from-steel. This is in turn dependent upon an interrelation of numerous factors such as:

(a) The current and expected conditions of demand for his output, which will tend to be complex.[9]

(b) His current and expected costs of production, including not only the cost of the steel he uses, but many other costs as well.

(c) The institutional arrangements of the market in which he sells his products-made-from-steel.

(2) The amount of steel he uses per unit of product-made-from-steel, which will depend upon

(a) The technological characteristics of his product-made-from-steel; of steel and substitute raw materials; and of his production methods.

(b) The price of steel.

(c) The cost of using substitutes for steel.[10]

C. STEEL IS USED IN THE PRODUCTION OF MANY WIDELY DIFFERING KINDS OF PRODUCTS-MADE-FROM-STEEL

That products-made-from-steel are almost innumerable and widely diverse in kind is a point that need not be labored. One has only to observe the number of products-made-from-steel which enter into everyday activity.

If the factors, and the relations among the factors, determining the outputs of all types of products-made-from-steel were more or less identical, the diversity of products-made-from-steel would present no great analytical difficulties in determining the demand for steel. It is obvious, however, that since products-made-from-steel enter into so many differing aspects of economic activity, the determinations of their outputs must also differ greatly. The way in which the output of refrigerators is determined is certainly much different from that for automobiles, and that for automobiles different from that for battleships.

It is clearly an impossible task to make an analysis of the output of every type of product-made-from-steel.[11] Thus again we have the index number problem of combining the many products-made-from-steel, the factors which determine their outputs and the quantity of steel used per unit of output into a reasonable number of economic composites.[12]

D. STEEL IS LARGELY USED IN THE PRODUCTION OF DURABLE GOODS[13]

The most important consideration involved in the analysis of the way economic factors act in relation to each other in determining the demand for steel is that the major part of the quantity of steel sold is used in the production of *highly durable* products-made-from-steel.[14]

It is elementary economics to observe that goods are valuable—that is, can command a price on the market—only for the services they provide.[15] Thus the demand for goods essentially is derived from the demand for the services of the goods.

The peculiar characteristic of *durable* goods is that they can provide services over a long period of time. Once a stock of durable goods has been built up—as is true in advanced economic societies—it is possible to obtain an almost undiminishing flow of services from them for a long period of time *without the production of any new durable goods. Consumption*, that is, may go on without a corresponding *production* of new durable goods. New durable goods will be produced only when it is economically desirable to replace "worn out" durable goods and to

[9] If the product-made-from-steel is a *producers'* good, such as a machine, the conditions of demand will tend to be especially complex, since they must in turn be derived from the output of a further product.

[10] The cost of using substitutes will depend not only upon the price of the substitute itself, but also upon:
(i) The cost of the machinery, labor, etc., that the use of the substitute requires.
(ii) The gain or loss in sales volume that the use of the substitute might entail. It should be emphasized that machines and labor, as well as raw materials may be, at least in part, substituted for steel. Thus, a reduction in the costs of labor may lead to the use of more labor per unit of output and reduce the quantity of steel used, through reduction of fabrication losses by more careful processing.

[11] Inasmuch as the production of a few types of products-made-from-steel takes the major part of the quantity of steel sold, the problem is not as difficult as it might appear. Thus the main types could be analyzed and combined together as representing the demand for steel, without serious loss of accuracy from the ommission of the many less important products.

[12] Whether this can be accomplished by the usual index number techniques without serious loss of information or without producing spurious results is a question that has not yet been satisfactorily answered.

[13] See C. F. Roos and V. von Szeliski, "Factors Governing Changes in Domestic Automobile Demand" in *The Dynamics of Automobile Demand* (General Motors Corporation, New York City, 1939).

[14] Tin plate, which is used mainly in the production of tin cans, is the most important exception.

[15] The service which apparently non-useful goods provide is the satisfaction of ownership.

enlarge the stock of durable goods. Thus it is obvious that the production of new durable goods tends to be largely dissociated from the consumption of the services of the stock of durable goods. For the same reason, the amplitude of cyclical fluctuations in the production of new durable goods will tend to be greater than the variations in the consumption of durable goods and in the production and consumption of perishable goods. Since the demand for steel is derived largely from the production of new durable goods, it follows that there will be great cyclical fluctuations in the quantity of steel sold.

Upon what factors does the demand for new durable goods depend? Inasmuch as the conditions of demand for *producers'* durable goods differ in some respects from those for *consumers'* durable goods, each of these types will be discussed separately.

(1) *Factors Affecting the Demand for New Producers' Durable Goods.*—Broadly speaking, a producer will not purchase a new durable producers' good unless he can reasonably expect that the return attributable to the new good over its "life span" will be sufficient to cover all the costs (including a reasonable profit) attributable to the purchase and use of the good. That is, the purchase must be expected to be a profitable one.

Among the most important factors determining the profitability of such purchases are:

(a) The current demand and the future demand expected by the producer for his output of goods and services.
(b) His present stock (number of units, age and efficiency of the units, and expected life span of the stock) of durable goods.
(c) The purchase price of the new durable good, including financing charges.
(d) The expected life span and efficiency of the new durable good. That is, the expected life "capacity" of the new durable good.
(e) The "costs of using" the good—i. e., the labor, material, managerial costs, etc., involved in the use of the good.
(f) The expected sale price per unit of the output of the good.
(g) The current and anticipated costs of (including the "costs of using") substitutes, such as labor, for the new durable goods.

(2) *Factors Affecting the Demand for Consumers' Durable Goods.*—The most important factors affecting the demand for consumers' durable goods are: [16]

(a) The current and anticipated amount of consumers' disposable cash income.
(b) The distribution of such income among economic classes.
(c) The size (number of units, age distribution, efficiency, and expected life span) of the stock of consumers' durable goods.
(d) The present and anticipated price of the new durable good.
(e) The costs of operating (including maintenance) the new durable good
(f) The cost of obtaining competing consumer services, including the "costs of living."
(g) Consumers' tastes.

It is apparent that the *demand* for new durable goods is determined by a complex composite of factors. Moreover, not all of the factors are directly measurable. Since the complete "fund of services stored" in durable goods can be used up (consumed) only over a more or less long period of time, *anticipations* are of paramount importance in determining the output of new durable goods. Thus there arises the problem of "measuring" changes in producers' and consumers' states of mind.[17]

There is a further and very important analytical problem. Since the amount of any commodity bought and sold depends not only on its price but also on a complex set of other factors, an analysis which attempts to isolate the influence of price is more difficult when the other factors are numerous, important, and subject to great or rapid changes. If, for example, as is the case for certain staple agricultural commodities, only a few factors other than price tend to be important in determining the quantity sold, and tend also to follow a slow and regular routine of change, the problem of isolating the effect of price is simplified. In the case of durable products-made-from-steel, however, factors other than price are numerous, exert very important effects, and tend to have large and irregular variations.

[16] See Roos and von Szeliski, *op. cit.*, for an analysis of the demand for automobiles.
[17] Inasmuch as current anticipations depend for the most part on the recent and current behavior of factors which in many cases can be measured, an approximate measure of anticipations can often be obtained from study of the measurable factors. See, for example, pp. 22–23.

Thus the problem of isolating the effect of the price of steel on the quantity of steel sold is exceedingly difficult.[18]

E. STEEL IS DURABLE AND CAN BE STORED

Since steel itself is durable, it may be kept in stock for fairly long periods without serious physical deterioration.[19] Thus, purchasers of steel may currently buy more steel than they require for current (or anticipated near future) consumption, building up a stock of steel for future production requirements. Conversely, the building up of such a stock in the past enables a steel purchaser currently to *buy* less steel than he *consumes*, the balance of such consumption coming from depletion of his steel inventories. If *changes* in the size of steel inventories in the hands of consumers (buyers) tend to be large, then it is obvious that the size of such inventories is an important factor influencing the sales of steel producers.

The size of steel inventories in the hands of consumers [20] will depend for the most part on:

(1) Buyers' anticipations as to future prices of steel.
(2) Their expected production requirements, which will depend largely on their expected sales of products-made-from-steel.
(3) The expected length of time it will take to get delivery from steel producers on future orders of steel.
(4) The cost of carrying such inventories.

If the steel buyer expects that prices of steel shortly will be higher, or that near-capacity operations of steel producers may delay delivery on his orders at a time when his steel requirements will be high, he may currently buy more than he needs for current consumption, stocking steel as protection against future higher prices or delivery delay. On the other hand, if his steel requirements turn out to be smaller than expected, he may find himself with unnecessarily large inventories of steel on hand. Thus he may consume from stock, curtailing his buying below his current production requirements.

However, such changes in inventories, which are largely speculative, for the most part exert only a short run effect on steel buying. The effect usually is a short run shift in the time of the actual purchases, without changing the total amount of steel bought over a one or two year period from what it otherwise would have been.

The reasons for this are:

(a) Inventories of steel cannot be reduced below a certain minimum (which depends largely on the level of the producers' operations) without serious inconvenience. This is especially true when there is danger of delay in delivery of orders of steel.
(b) On the other hand, the cost of carrying inventories and the risks involved tend to set an upper limit to their size. The larger the inventories, the higher is the carrying expense, and the further into the future must the user anticipate prices of steel and his own production requirements. Such anticipations become more risky as they extend longer into the future. The situation seldom arises when the costs of carrying are low enough, and the future certain enough to justify changing inventories by more than a few months' production requirements.

This is not to say, however, that *year-to-year* fluctuations in steel inventories are unimportant in explaining *year-to-year* changes in steel buying. In periods of rapid change in business activity and business outlook—such as the period from the middle of 1936 to the middle of 1938—changes in the size of inventories may be very important.

Thus in analyzing the demand for steel it is necessary to include as a factor net changes in steel inventories in the hands of steel buyers, or in the absence of such data, the factors upon which the size of steel inventories depends.

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[18] An excellent discussion of the problem of isolating the effect of price in the derivation of quantity-price demand relations is contained in Henry Schultz, *Theory and Measurement of Demand* (Chicago, 1938), pp. 61–104.

[19] There are, of course, exceptions to this statement; for example, cold reduced auto sheets should be used promptly.

[20] This section deals only with changes in inventories of steel in the hands of *consumers*. However, steel producers themselves may keep stocks of steel. Inasmuch as the largest part of the steel produced is made to order to the buyer's specification, changes in inventories of finished steel in the hands of producers are ordinarily small. There is some evidence, however, that changes in inventories of steel ingots, semifinished steel, and *standard* types of finished steel in the hands of producers may at times be quite large. Such changes of inventories in the hands of *producers* are relevant to the discussion of this paper only if it is necessary to derive estimates of steel sales from figures on steel production. For a discussion of the latter problem see Appendix VIII, Section 1.

F. STEEL IS NOT SOLD IN A SINGLE ONE-PRICE MARKET [21]

Largely because steel producers and steel buyers are located over a wide area, and also because it is impossible at all times for all buyers and sellers of steel to have "perfect knowledge of the market," there tend to exist at any time certain differentials between the prices paid for the same type of steel by different buyers.[22] These differentials are of two main types:

(1) First there are the more or less permanent price differentials between buyers in different geographic areas. These differentials have arisen partly from varying costs of assembling raw materials and converting them into finished products at different locations, partly from varying costs of transportation of the finished product into different areas, partly from the forces of competition, and partly from certain long established institutional arrangements in the pricing of steel.[23] These same forces, however, tend to keep the differentials more or less constant, so that year to year changes in the price of steel are about the same in all areas.[24]

(2) The second type of price differential is the concession from the prevailing price. Because of competition among steel producers, it is obviously advantageous at certain times for certain steel producers to offer steel at lower prices than their competitors.[25] By so doing they can often take a substantial share of the steel market away from competing steel companies.[26] However, the same forces of competition require that such price concessions be kept from the knowledge of competitors; otherwise the concessions will be met and become general.[27] When concessions do become general, data on the price cuts ordinarily become market knowledge available to the steel trade journals who report "going" market prices.[28]

The combination of these two types of price differentials means that at any time there tends to be more than one price for the same type of steel. Thus there arises the problem of combining these prices into single composite prices for the various types of steel.[29]

IV. Method of Analysis

In order to make the discussion of the following pages clear it is necessary to define the terms "quantity of steel sold," "products-made-from-steel," "inventories of steel in the hands of producers of products-made-from-steel," and "jobbers' stocks."

(i) By *quantity of steel sold* is meant the physical quantity, i. e., tonnage of steel sold by *steel producers.*

(ii) A *product-made-from-steel* is any finished producers' or consumers' good (*not* service) into which steel enters as an actual raw material of production. Automobiles, steel bridges, rails-laid are examples. Products-made-from-steel are of two broad categories:

(a) Products-made-from-steel *produced for sale.* Automobiles, household appliances, agricultural implements are in general examples of this type.

(b) Products-made-from-steel *produced for the producer's own use.* Rails-laid, bridges and highways, pipe-lines-laid are examples of this category.

[21] This section is not to be interpreted either as an attempt to describe fully or to appraise the pricing and selling arrangements in the market for steel.

[22] Obviously this problem is not confined to the marketing of steel. Such price differentials will almost always arise when there is more than one seller and one buyer.

[23] Discussions of the basing-point method of pricing are especially relevant here. See the description in Daugherty, de Chazeau and Stratton, *Economics of the Iron and Steel Industry* (McGraw-Hill Book Company, New York, 1937), Vol. I, pp. 533-544.

[24] Mill net indexes for different basing point areas support this conclusion.

[25] Price concessions are especially advantageous (from the short-run point of view of the individual seller) for producers (1) having relatively small steel producing capacity (2) operating at a low percentage of capacity. By making concessions such producers may gain enough business to raise their operation to a rate at which they can make substantial profit gains (or loss reductions).

[26] See the recent discussion in Paul M. Sweezy, "Demand under Conditions of Oligopoly," *Journal of Political Economy*, v. XLVII, No. 4 (Aug., 1939), pp. 568 *et seq.*

[27] See Sweezy, *op. cit.*

[28] Undoubtedly there are times when price concessions are important, and when it is difficult for the trade journals to verify or measure the extent of the concessions. Ordinarily the trade journals can measure the extent of the concessions only when the market for some type of steel "breaks wide open."

[29] This, too, is a difficult index number problem that has never been satisfactorily solved. Ideally the solution requires separate demand analyses for each group of buyers subject to the same price differentials.

(iii) By *inventories of steel in the hands of producers of products-made-from-steel*—or simply *steel inventories*—is meant the total of:

(a) The physical quantity of steel on order and held in raw material inventories by producers of products-made-from-steel; and

(b) The equivalent measure of the amount of steel held by producers in work-in-process inventories (partially fabricated products-made-from-steel).[30]

(iv) The term *jobbers' stocks* means the physical amount of steel held by jobbers—i. e., steel middlemen.

The quantity of steel sold in any year then is obviously equal to the number of units of products-made-from-steel produced in that year multiplied by the average amount of steel used in the production of each, plus the net change in steel inventories from the beginning to the end of that year plus the similar net change in jobbers' stocks.

For example, suppose there is only one type of product-made-from steel, say automobiles. During the year automobile producers manufacture 5 million cars using 1.5 gross tons of steel in the production of each car. Then 7.5 million gross tons of steel would be required to produce the 5 million cars. At the beginning of the year automobile producers held 0.5 million gross tons of steel in steel inventories (in unfabricated form or in equivalent measure in work-in-process), and 1.0 million gross tons at the end of the year. It is obvious then that automobile producers (producers of products-made-from-steel) must have bought 8.0 million gross tons of steel during the year, 7.5 million of which was used in production and 0.5 million to increase their steel inventories. Of this 8.0 million tons, 7.0 million were bought directly from steel producers, and 1.0 million from jobbers. Jobbers meanwhile increased their stocks from 1.0 million to 2.0 million tons, so that they must have bought 2.0 million tons from steel producers, 1.0 million to increase their stocks, and 1.0 to sell to producers of products-made-from-steel.

Steel producers then must have sold 9 million gross tons of steel during the year:

7.5 million of which went into the production of products-made-from-steel;
0.5 million to increase the steel inventories of producers of products-made-from-steel; and
1.0 million to increase jobbers stocks.

It is therefore clear that in determining the effect of a change in the price of steel on the quantity of steel sold in any year, it is necessary to find out how such a price change would affect:

(i) The physical volume of production of products-made-from-steel.
(ii) The average quantity of steel used in the production of each unit of product-made-from-steel.
(iii) The net change in steel inventories.
(iv) The net change in jobbers stocks.

It will be helpful to consider how each of these is determined.

(1) Volume of Production of Products-Made-from-Steel. The output (number of units) of products-made-from-steel in any year may be looked upon as made of three parts:

(a) The quantity of such products *sold.*
(b) The net change in producers' inventories of products-made-from-steel produced for sale.
(c) The output of products-made-from-steel manufactured for the producer's own use.

The sum of the first two is obviously equal to the *output* of products-made-from-steel *produced for sale.*

(a) The main factors which determine the volume of sales of products-made-from-steel have been discussed in Sections III–B and III–D. Since the price of steel will in general affect the volume of sales only indirectly through its effects on the prices of products-made-from-steel, the problem becomes the two-fold one of first isolating the influence of the prices of products-made-from-steel on their sales, and then determining how the price of steel affects prices of products-made-from-steel.

This second problem is itself an extremely difficult one, for the prices of products-made-from-steel depend on many factors beside the price of steel

[30] That is, the amount of steel used in the production of inventories of partially finished products-from-steel.

The price of steel will exert its effect on the price of products-made-from-steel through its effect on their costs of production, and the importance of the effect will depend in large measure on the importance of steel costs in the total unit costs of production.

In general it seems likely that an increase in the price of steel, other things remaining the same, will increase unit costs of production and thereby the prices of products-made-from-steel. The increase in the prices of products-made-from-steel would probably lead to a reduced number of units sold. For a reduction in the price of steel, the converse is probably true.

Moreover, it is reasonable to assume that ordinarily:

(i) Sales of products-made-from-steel will not be very responsive to changes in their prices. That is, changes in the prices of products-made from-steel do not lead to much larger percentage changes in sales.[31]

(ii) Changes in the unit costs of production of products-made-from-steel lead to approximately equivalent changes in their prices.

(iii) Changes in the price of steel generally lead to changes in the costs of production of products-made-from-steel in approximately the proportion of unit steel costs to total unit costs of production.

Since steel costs are generally only a small fraction of the total costs of production of products-made-from-steel, it follows that one may reasonably expect changes in the price of steel to lead to much smaller percentage changes (in the opposite direction) in the sales of products-made-from-steel.

(b) The size of inventories (in the hands of producers) of products-made-from-steel produced for sale depends in major part on:

(i) The current and expected volume of sales of products-made-from-steel.

(ii) Current and expected labor costs of production of products-made-from-steel.

(iii) The current and expected length of time required to make delivery on orders of products made-from-steel.

Of these three factors it seems reasonable to expect that only the first would be significantly affected by changes in steel prices. Since net changes of inventories of products-made-from-steel tend to be small relative to sales and since sales are only slightly responsive to changes in the price of steel, it thus seems likely that steel price changes are of negligible importance in affecting steel sales *through* their effects on inventories of products-made-from-steel.

(c) The major factors determining the output of products-made-from-steel produced for the maker's own use have been discussed in section III-D. The price of steel will affect the output of such products mainly through its effects on their costs of production, maintenance, and operation. Since the output of durable producers' goods is probably not very responsive to changes in their costs of production, operation, and maintenance, and since steel costs are generally only a very small part of such costs, changes in the price of steel lead to much smaller percentage changes (in the opposite direction) in the output of products-made-from-steel manufactured for the producers' own use.

(2) The Average Amount of Steel Used in the Production of Each Unit of Products-Made-From-Steel. In section III-B it was pointed out that the amount of steel used per unit of output of a product-made-from-steel depends largely on:

(a) The technological characteristics of the product-made-from-steel; of steel and substitute raw materials; and of the production methods.

(b) The price of steel.

(c) The cost of using substitutes for steel.

The first set of factors (a) however, tend to change very slowly, so that they may be classed as "long-run" factors which are relatively unimportant in determining year to year fluctuations in the average amount of steel used per unit of product-made-from-steel.

A rise (or fall) in the price of steel relative to the cost of using substitutes will ordinarily lead to a decrease (or increase) in the amount of steel used per unit of product-made-from-steel. However, it is extremely doubtful if a change in steel prices in any year has more than a negligible effect in inducing substitution in that year (or even in the next two or three). The reasons for this are obvious:

(i) The tastes of buyers of products-made-from-steel tend to change very slowly, and thus retard the rate of substitution.

[31] The demand for durable goods is generally not very elastic.

(ii) There are a limited number of substitutes that are economically and technically suitable. Moreover technical conditions of production rigorously limit the amount of substitution that can take place.

(iii) The use of substitutes for steel, or the substitution of steel for other factors of production generally requires great changes in the type of plant, equipment, and labor required. A change in the price of steel relative to the cost of substitutes must normally be substantial and persist for several years before the investment and labor training costs required by substitution will be undertaken.

(3) Net Changes in Inventories of Steel in the Hands of Producers of Products-Made-From-Steel, and Net Changes in Jobbers' Stocks.

The main factors determining net changes in inventories of steel in the hands of producers of products-made-from steel and net changes in jobbers' stocks were discussed in section III-E, and will not be elaborated further here.

Once it is known how (1) the output of products-made-from-steel, (2) the average quantity of steel per unit of this output, (3) inventories of steel, and (4) jobbers' stocks are determined—including the influence of the price of steel in such determination, then it will be evident how the quantity of steel sold is determined, and how steel price changes would affect the quantity of steel sold.

Although the above approach is ideal in that it enables the analyst to get a clear picture of the separate ways the price of steel acts in determining the quantity of steel sold, it is impossible to follow it here. Information is lacking at critical points:

(1) Data on the output of important products-made-from-steel are lacking. Moreover, even if output data were complete, the great diversity of products-made-from-steel as well as the fact that they change in nature from year to year makes the problem of combining them into an economic composite an almost impossible one.[32]

(2) Data on the quantity of steel used in the production of different types of products-made-from-steel, as well as data on steel inventories and jobbers' stocks are also almost completely unavailable.

Thus it might seem that the whole problem would have to be stranded without an answer. However, it is obvious from the discussion of the previous pages that the quantity of steel sold depends upon the *factors which determine* (*R*) the output of products-made-from-steel, (*S*) the average quantity of steel per unit of the output, (*T*) steel inventories, and (*U*) jobbers' stocks. Thus if the most important of these basic determining factors can be measured, if such measures are available, and *if reasonable hypotheses*—determined from economic logic and empirical observation—*can be set up as to the relation between these factors*, then the problem may not be insoluble. However, it should be obvious that the results obtained by such procedure will not be as conclusive as those obtained by the approach outlined on preceding pages, since there will not be the intermediate checks on hypotheses as to the demand relationships that the first approach offers.

The problem remaining then is a threefold one:

(1) The clear definition and measurement of the most important factors determining the above economic variables (R), (S), (T), and (U).

(2) The setting up—on *a priori* and empirical grounds—of an hypothesis as to the way these factors act together in determining (R), (S), (T), and (U), and thus the quantity of steel sold.

(3) The statistical testing of the hypothesis.

V. Factors Which Might Be Expected to Influence the Quantity of Steel Sold [33]

From the discussion of the previous pages it is clear that the following factors might reasonably be expected to influence the quantity of steel sold:

(1) The price of steel—including both the level and the direction of change.

(2) Consumers' disposable cash income.

(3) The distribution of the income among income classes.

(4) The stock (number of units and efficiency) of durable goods—both consumers' and producers'.

(5) The cost of living.

(6) The prices of goods and services which compete with products-made-from-steel for the outlays of producers and consumers.

(7) The costs of maintaining and operating products-made-from-steel.

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[32] See section III-C.

[33] See Appendix VIII below for further discussion of the problem of defining and measuring the important factors in the demand for steel.

(8) Industrial profits.

(9) The psychological atmosphere—i. e., producers' and consumers' anticipation as to future economic conditions.

(10) Industrial production.

Since some of these variables are very highly related to others, however, and since others tend to change slowly and smoothly from year to year, certain of them were omitted in the actual analysis. The factors which were used in the final statistical analysis were:

(1) The price of steel—both its level and direction of change.
(2) Industrial production—both its level and direction of change.
(3) Consumers' income—both its level and direction of change.
(4) Industrial profits—both its level and direction of change.
(5) The cost of living.
(6) A time-trend variable.

As will be pointed out below [34] these six factors can be taken as approximately representing all of the preceding ten.

VII. The Period Studied

The period 1919 to 1938 was chosen for analysis for the following reasons:

(1) It was a long enough period to provide observations on the nature of the demand for steel under practically all types of conditions so that somewhat general inferences could be drawn from the data. The period covered includes both years of boom and years of decline.[35]

(2) This period is of more current interest than earlier periods, because the inferences drawn are of more accurate current application.

(3) Data for years prior to 1919 are very often not available.[36]

However, after the analysis was begun it was found desirable to exclude the years 1919–1921 from some of the demand relations. The analysis indicated that the situation in these three years was abnormal because of the World War. The magnitude and the direction of the fluctuations in economic activity were not typical of the rest of the period, and the inclusion of these years, it was thought, obscured the ordinary steel demand relations. The statistical analysis, however, was in most cases carried through for both the complete and the abbreviated periods.

Annual data, rather than monthly data or data for periods longer than a year, were selected for analysis for three reasons:

(1) Monthly data were not available for some of the series.

(2) The use of monthly data unnecessarily complicates the analysis for the purposes of this paper because it introduces short-term factors—such as seasonal variations and short-run speculative activity—which are practically excluded by using annual data.[37]

(3) The use of longer-period data was considered undesirable because

(a) A much longer period of years would have to be studied in order to get a sufficient number of observations.

(b) The effect of year to year changes in demand conditions on steel sales was desired.

(e) It is extremely difficult to isolate the causative effect of price when longer-period data are used. The use of longer-period data introduces many new factors into the analysis which can be considered as unimportant in studying year to year changes.

VII. The Demand Relation Hypotheses [38]

The final problem remaining prior to the actual statistical determination of the demand for steel is that of setting up an economically logical hypothesis as to the way the factors considered in section V act together in determining the quantity of steel sold. This is by far the most important part of the whole analysis

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[34] See section VII-A.

[35] When annual data are used, the statistical technique here employed requires a period as long as fifteen or twenty years in order to get a sufficient number of observations. The reasons for this are technical and will not be discussed here.

[36] For example, reliable data on consumers' income, industrial profits, the cost of living, and industrial production are not available in good form before 1919.

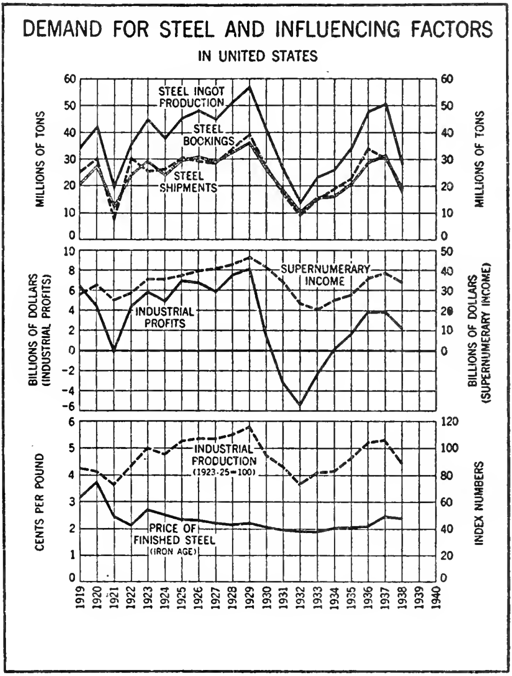
[37] Ideally, of course, it would be desirable to use monthly, or even shorter period data, since intra-year variations tend to affect annual measures. However, the extra analysis was considered to be too great to compensate for the small loss of information involved in using annual data.

[38] See Roos and von Szeliski, *op. cit.*, section III.

of the demand for steel. It is obvious that the final inferences drawn—concerning the influence of the price of steel on the quantity of steel sold—will depend on the demand relation hypothesis set up.

The problem of setting up a demand relation hypothesis for steel is a perplexing one. Products-made-from-steel are so numerous and so diverse that it is almost impossible to analyze the way economic factors act together in determining the output of even the most important. Moreover, data which would be helpful are lacking at critical points. Then, too, information as to the economic-technical problem of the amount of steel used per unit of products-made-from steel is almost

CHART 1



completely unavailable. A similar situation exists for the problem of setting up an hypothesis as to the determination of steel inventories.

The lack of information at critical points, and the absence of a completely suitable body of economic theory have forced recourse to what is largely an empirical determination of the demand hypothesis.

A. ACTUAL VARIABLES INCLUDED IN THE DEMAND RELATION HYPOTHESIS

Five general hypotheses as to the actual variables to be included in the demand relation hypothesis were set up. The basic variables included in these various hypotheses are shown in Chart 1 and Appendix I.

The five general hypotheses were:

The quantity of steel sold [39] depends upon:

(h–1) The price of steel,[40] and the volume of industrial production.[41]

(h–2) A time-trend variable in addition to those of (h–1).

(h–3) The same variables as (h–2) and in addition two variables measuring respectively the rate of change in the price of steel and the rate of change in the volume of industrial production.[42]

(h–4) The price of steel,[40] a time-trend, consumers' supernumerary income,[43] and industrial profits.[44]

(h–5) The same variables as (h–4), and in addition three variables measuring respectively the rates of change in the price of steel, supernumerary income, and industrial profits.[45]

In (h-1) it was assumed that industrial production measured accurately the composite influence of all factors affecting the demand for steel except the price of steel. It was assumed that industrial production reflected the composite effect of the most important demand factors, viz., industrial profits, consumers' income, the replacement pressure on the stock of durable goods, and, also indirectly the psychological outlook. Since all of these factors have actually been more or less highly correlated with industrial production, such an assumption is not unreasonable.

In (h-2) an additional time-trend factor was included. The time-trend was included explicitly as a variable to act as a proxy measure for all factors influencing the demand for steel which tend to change slowly and smoothly over a long period of time. Thus it serves as a composite measure for such factors as population, the size of the stock of durable goods, and long time changes in various price and cost levels (including the level of the prices of steel), industrial technology, and people's tastes. The inclusion of such a variable makes it possible partly to isolate the effects of these long-run factors.

It is commonly recognized that a very important factor determining the current level of activity in durable goods production—and thus in steel sales—is the business outlook of producers and consumers, their anticipations as to future prices, profits, income, etc. Such anticipations are very largely determined by the rapidity and direction of change in recent and current business activity. If present levels of activity are higher than they have been in the recent past, it is easier to believe that conditions will continue to improve than if activity is currently on the decline. For this reason the rate of change of industrial production was included in (h-3) as a factor measuring changes in anticipations. Similarly the rate of change in the price of steel has been included in (h-3) as a measure of steel buyers' anticipations as to the near future price of steel.

In (h-4) and (h-5) industrial profits and consumers' supernumerary income and their respective rates of change have been substituted for industrial production and its rate of change to measure the composite of factors other than the price of steel influencing the demand for steel.

Of the five general hypotheses it would seem that (h-5) is probably the most complete and the most reasonable. The final answer, of course, cannot be given until the form of the five general hypotheses is set up and tested.

[39] Measured by steel ingot production, and estimated shipments and bookings. See Appendices II and VIII.

[40] The Iron Age composite price of finished steel. See Appendix VIII.

[41] The Federal Reserve Board index of manufacturing production excluding iron and steel. See Appendices VI and VIII.

[42] The rates of change are for any year in each case measured by the link relative for that year. (The link relative is equal to that year's figure divided by the figure for the previous year.)

[43] See Appendix IV.

[44] See Appendix V.

[45] The measure of the rates of change is the link relative, except for profits where the rate of change is measured by first differences. (The first difference for any year is equal to the figure for that year less the figure for the previous year.)

B. THE FORM OF THE DEMAND RELATION HYPOTHESIS

The next step in the analysis is the formulation of an hypothesis as to the way the economic variables act together in determining the demand for steel.

Each of the five general hypotheses outlined above was studied by familiar graphical multi-factor correlation techniques,[46] in order to find out

(i) What mathematical relation seems to be the most reasonable expression of the relation between the factors.

(ii) Whether any of the five general hypotheses should be discarded or modified.

The graphical analysis indicated that for all of the hypotheses a simple additive relation would probably give as satisfactory results as any other (such as the multiplicative or combinations of the additive and multiplicative).[47]

It was also decided from the graphical analysis to use only (h-2), (h-4), and a modification of (h-3) which excluded the rate of change in the price of steel [48] and the time-trend.

Thus four mathematical relations were formulated for further examination by mathematical statistical techniques. Translated verbally these relations were:[49]

Relation I.—Production of steel ingots and castings is equal to:

Price of steel multiplied by a constant value
plus Industrial production multiplied by (another) constant value
plus Time (in years) multiplied by (another) constant value
plus a constant balancing value.

Relation II.—The same as relation I plus
The rate of change of industrial production multiplied by a constant value and excluding the time-trend.

Relation III.—Estimated steel shipments are equal to:

Price of steel multiplied by some constant value
plus Industrial profits multiplied by some constant value
plus Supernumerary income multiplied by some constant value
plus Time (in years) multiplied by some constant value
plus a constant balancing factor.

Relation IV.—The same as relation III except that estimated steel bookings were substituted for estimated steel shipments.[50]

The only problem remaining was to find the numerical values of the various constant multiplying and balancing factors in the relations. Once this was done it was easy to find out how much of a change in the quantity of steel sold (as represented by bookings, shipments, or ingot production) has been associated with a given change in the price of steel, industrial production or any other of the independent variables.

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[46] See Henry Schultz, *op. cit.*, pp. 184–186, including the sources cited in footnote 7 on p. 185.

[47] The additive relation has in its favor the simplicity with which the statistical analysis may be carried out. More complicated forms of mathematical relations have, of course, certain logical advantages arising from their greater generality. It is well known, however, that if it is desired to study a demand relation near the average values of its variables, the linear arithmetic form gives practically the same results as more complex forms. Since it was considered feasible to study the relation only near its average values, and since there was no clear indication from the graphical analysis that a more complicated form was a more likely one, the additive relation was selected. However, the statistical analysis was also carried through for (h-2) using a simple multiplicative (linear logarithmic) relation. See Appendix VII.

[48] The graphical anaylsis indicated that no significant information would be added by the rate of change terms in (h-5) and the rate of change of the price of steel in (h-3), and that the inclusion of these terms might break down the statistical analysis.

[49] These relations are stated in mathematical form in Appendix VII.

[50] See Appendix VII.

VIII. The Statistical Findings

The constants were determined by the least squares multiple correlation technique.[51] Final equations for the various relations are shown in Appendix VII. The same statistical procedure also gives the percentage of the total variation in the quantity of steel sold over the period studied that is accounted for by the economic factors included in the relations, and the amount that can be directly attributed to the separate variations of each of the factors.[52] These percentages are shown below in Table 1.[53]

Table 1

Relation Number	Quantity of Steel Sold Measured by	Percent of Variation in Quantity of Steel Sold						
		Accounted for by All Factors in Demand Relation	Directly attributable to variation in					
			Price of steel	Industrial production	Industrial profits	Supernumerary income	Rate of change of industrial production	Time trend
I	Production of Steel Ingots and Castings	96	0	88	--------	--------	--------	0
II	Production of Steel Ingots and Castings	96	9	81	--------	--------	1	--------
III	Estimated Steel Shipments	91	1	--------	41	19	--------	0
IV	Estimated Steel Bookings	90	9	--------	90	6	--------	1

Two conclusions are indicated by Table 1:

(1) In each of the demand relations, the included factors accounted for 90 percent or more of the observed variation in the respective measure of steel sales.

(2) Over the period studied only a small fraction (10 percent or less) of the variation in steel sales was directly attributable to variation in steel prices, while the major part of the variation was accounted for by included factors other than the price of steel.

It should be emphasized again, however, that these conclusions depend upon the accuracy of three assumptions:

(a) That the demand relations set up are good approximations to the true demand relations both as to factors included and the form of the relation.

(b) That the variables used more or less accurately measure what they are supposed to.

(c) That the statistical technique yields approximately correct constant values for the demand relation.

In appraising the second conclusion drawn from Table 1 it should be kept in mind that the relative proportion of the total variation of steel sales attributable to variation in the price of steel over any period will depend in part on the amount of variation in steel prices relative to variation in the other factors. Over the period 1922 to 1938 relative variation in steel prices was considerably less than the relative variation in the other factors.

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[51] For an excellent description of the techniques followed see Schultz, *op. cit.*, Appendix C.

[52] For a rigorous definition of the term "variation" as used here, and the details of the procedure used in attributing variation in steel sales to the various "causative" economic factors see Schultz, *op. cit.*, pp. 741-743. Simply stated, the percentage of variation directly attributable to any factor is the ratio of the variation in the quantity of steel sold which would have taken place if only that factor had varied in the way it did, to the variation in the quantity of steel sold that actually took place.

[53] Except for Relation II the period studied was 1922 to 1938; for Relation II, it was 1920 to 1938. It will be noted that in all cases the sum of the percentages of variation directly attributable to the separate factors is not equal to the total variation accounted for by all the factors in the relation. The reason for this is as follows: In obtaining the percentages attributable to any factor we assume that none of the other factors varied. Actually, of course, this is not true; all of the factors varied, the changes in some factors tending to *increase* the quantity of steel sold *while* other changes were tending to *decrease* sales. The net result of all the simultaneous changes is the amount of variation accounted for by all the factors.

A more useful measure of the importance of the price of steel is the elasticity of demand coefficient. This coefficient is the ratio of the percentage change in the quantity of steel sold to the corresponding percentage change in the price of steel, other factors being fixed at some level.[54]

Table 2 below shows the values of the elasticity of demand found in the four demand relations when the values of the demand factors are at their average levels for the periods studied.[55]

TABLE 2.—*Elasticity of demand for steel*

Relation number:	*Elasticity*
I	+0. 12
II	+0. 52
III	−0. 21
IV	−0. 88

The values are consistent in this very important respect: they indicate that at most *a one percent decrease in the price of steel would cause* (*other factors remaining the same*) *less than a one percent increase in steel sales* (*and conversely*). If this is true, and if fluctuations in the other factors continue to be as great and as important as they have been in the past, the volume of steel consumption cannot be stabilized by compensatory changes in the price of steel.

Which of the above values of the elasticity of demand is the most likely? The values obtained from Relations III and IV are probably better than those from I and II for the following reasons:

(a) On *a priori* grounds it seems reasonable that a change in the price of steel would lead to a ch nge in the opposite direction in steel sales.[56] Relations I and II both indicate positive relations between steel prices and sales.

(b) As pointed out in Appendix VIII, steel ingot production is probably not as accurate a measure of steel sales as the estimates used in Relations III and IV.

(c) Industrial production (and its rate of change) is probably not as good a measure of the composite of factors other than price of steel as the combination of the two factors, industrial profits and supernumerary income.

The difference in the values obtained from Relations III and IV can be due only to the difference between the estimates of steel sales used in each case, for the relations are identical in other respects. From Chart 1 it is apparent that fluctuations in the steel bookings figures used in Relation IV tend to lead industrial profits, while steel shipments (used in Relation III) do so to much less degree. The reasons for the lag of shipments behind bookings are discussed in Appendix VIII. In Appendix VIII it is also pointed out that accounting profit figures tend to lag behind the current profit situation that they supposedly measure. An analysis of business history over the period 1919 to 1938 adds additional evidence that the profits figures ordinarily reported have a significant lag.

In the graphical analyses that were made of the various demand relations, there were clear indications that if the lags of shipments and industrial profits behind bookings were removed, Relations III and IV would both give about the same results for the elasticity of demand, yielding a figure of 0.3 to 0.4. The evidence and argument adduced in the preceding pages of this paper support the conclusion that such a value—or one even lower—for the elasticity of demand for steel is not a statistical happenstance, but a reality.

Although these findings are not absolutely conclusive in establishing this very low elasticity of demand for steel, they certainly afford no basis for the view that the price of steel is a practical medium for stabilizing production.

[54] A rigorous mathematical definition of the elasticity of demand is given in Appendix VII. It is also shown there that the elasticity of demand may vary as the price of steel and the other factors influencing the demand for steel vary.

[55] These values of the elasticity have been computed at the arithmetic mean point of the factors influencing the demand for steel.

[56] See the discussion of Section IV.

Appendix I. Basic Series Used in the Statistical Analysis

The basic series used in the statistical analysis are shown below in Table A-1. These series are also shown in Chart 1, p. 21.

Table A-1.—*Basic Series Used in Statistical Analysis*

Year	Steel Ingot Production [1] (thousands of gross tons)	Steel Bookings [2] (thousands of gross and net tons)	Steel Shipments [3] (thousands of gross and net tons)	Industrial Production [4] (1923-25=100)	Rate of Change of Industrial Production [5]	Industrial Profits [6] (billions of dollars)	Supernumerary Income [7] (billions of dollars)	Composite Price of Steel [8] (cents per pound)
1919	34, 671	25, 233	20, 783	85	----------	6. 419	28. 2	3. 115
1920	42, 133	30, 212	27, 217	83	98	4. 468	32. 8	3. 737
1921	19, 784	7, 609	12, 375	73	88	−0. 055	25. 0	2. 437
1922	35, 603	30, 391	23, 705	87	119	4. 380	28. 9	2. 124
1923	44, 944	25, 439	29, 173	100	115	5. 867	35. 5	2. 697
1924	37, 932	26, 214	24, 154	95	95	4. 998	35. 6	2. 505
1925	45, 394	30, 557	29, 639	105	111	6. 971	37. 5	2. 334
1926	48, 294	29, 138	30, 847	107	102	6. 774	39. 8	2. 315
1927	44, 935	28, 488	28, 827	107	100	5. 880	40. 6	2. 202
1928	51, 544	33, 761	32, 560	110	103	7. 566	43. 0	2. 165
1929	56, 433	39, 167	36, 197	116	105	8. 083	46. 8	2. 209
1930	40, 699	26, 977	26, 280	95	82	1. 366	41. 7	2. 048
1931	25, 946	17, 133	18, 431	86	91	−3. 145	34. 1	1. 957
1932	13, 681	9, 129	10, 385	73	85	−5. 375	23. 1	1. 901
1933	23, 232	15, 027	15, 607	82	112	−2. 379	20. 2	1. 879
1934	26, 055	18, 777	16, 222	83	101	0. 157	25. 1	2. 033
1935	34, 093	22, 751	21, 050	93	112	1. 674	27. 8	2. 058
1936	47, 768	33, 888	28, 766	104	112	3. 903	36. 0	2. 077
1937	50, 569	30, 212	31, 620	106	102	3. 872	38. 8	2. 464
1938	28, 350	19, 413	18, 176	89	84	2. 165	34. 0	2. 394

Sources:
[1] Appendix II, Table A-2, column (2).
[2] Appendix II, Table A-2, column (5).
[3] Appendix II, Table A-2, column (7).
[4] Appendix VI, Table A-6, column (6).
[5] These are the link relatives of the figures in the previous column.
[6] Appendix V, Table A-5, column (5). The figure for 1937 which was actually used in the computations was $3.959 billion. For this and the 1938 figure see Appendix V, p. 34.
[7] Appendix IV, Table A-4, column (8).
[8] *Iron Age*, January 5, 1939, pp. 198-199.

Appendix II. Estimation of Domestic Bookings and Domestic Shipments of Steel for Steel Industry as a Whole

The details of the computations used in estimating domestic bookings and shipments of rolled and finished steel from those of the U. S. Steel Corporation are shown below in Table A–2. See also Appendix VIII, pp. 50–51.

Table A–2.—*Estimation of bookings and shipments of steel for steel industry as a whole, 1919–1938*

Year	Production of Steel Ingots and Steel for Castings (thousands of gross tons)			Domestic Bookings of United States Steel Corporation [4] (thousands of gross and net tons)	Estimated Domestic Bookings: Steel Industry [5] (thousands of gross and net tons)	Shipments of Rolled and Finished Steel Products, Domestic, by the United States Steel Corporation [6] (thousands of gross tons and net tons)	Estimated Domestic Shipments: Steel Industry [7] (thousands of gross and net tons)
	United States Steel Corporation [1]	Steel industry as a whole [2]	Ratio of (2) to (1) [3]				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1919	17,200	34,671	2.0157	12,518	25,233	10,311	20,783
1920	19,278	42,133	2.1855	13,824	30,212	12,453	27,217
1921	10,966	19,784	1.8040	4,218	7,609	6,832	12,325
1922	16,082	35,603	2.2138	13,728	30,391	10,708	23,705
1923	20,330	44,944	2.2107	11,507	25,439	13,196	29,173
1924	16,479	37,932	2.3019	11,388	26,214	10,493	24,154
1925	18,899	45,394	2.4019	12,722	30,557	12,340	29,639
1926	20,307	48,294	2.3782	12,252	29,138	12,971	30,847
1927	18,486	44,935	2.4307	11,720	28,488	11,860	28,827
1928	20,106	51,544	2.5637	13,169	33,761	12,701	32,560
1929	21,869	56,433	2.5805	15,178	39,167	14,027	36,197
1930	16,726	40,699	2.4332	11,087	26,977	10,801	26,280
1931	10,082	25,946	2.5733	6,658	17,133	7,162	18,431
1932	4,929	13,681	2.7755	3,289	9,129	3,742	10,385
1933	8,047	23,232	2.8871	5,205	15,027	5,406	15,607
1934	8,660	26,055	3.0086	6,241	18,777	5,392	16,222
1935	11,131	34,093	3.0629	7,428	22,751	6,873	21,050
1936	16,908	47,768	2.8252	11,995	33,888	10,182	28,766
1937	18,532	50,569	2.7287	11,072	30,212	11,588	31,620
1938	9,397	28,350	3.0168	6,435	19,413	6,025	18,176

Sources:
[1] Records of the United States Steel Corporation.
[2] American Iron and Steel Institute, *Annual Statistical Report for 1938*, p. 15.
[3] Column (2) divided by column (1).
[4] Records of the United States Steel Corporation.
[5] Column (4) multiplied by column (3).
[6] Records of the United States Steel Corporation.
[7] Column (6) multiplied by column (3).

Appendix III. Revision of the U. S. Department of Commerce Estimates of National Income Payments

The estimates of the United States Department of Commerce for "national income payments"—which are probably the best estimates of "consumers' cash income" [1] are based in large part upon another of their national income estimates called "national income paid out".[2] In June, 1939, the estimates for the latter were revised by the Department of Commerce,[3] but corresponding revisions were not made in the income payment series. Thus it seemed desirable to revise the figures for income payments in view of the basic revisions in the "income paid out" series.

The details of the revision are shown above in Table A–3.

The revised estimates of "national income paid out" are shown in column (1), and the unrevised estimates in column (2). The unrevised estimates of "income payments" are shown in column (3). The *unrevised* estimates of "income payments" are based on the *unrevised* estimates of "income paid out".[4] The difference between the two (shown in column 4) is equal to:

"Direct relief payments,"
plus "Benefit payments under Social Security Act,"
plus "Annuities and refunds to Federal employees,"
plus "Veterans compensation" (Soldiers' Bonus),
less "Employer contributions under the Social Security Act,"
less "Employee contributions under the Social Security Act,"
less "Employee contributions under the Railroad Retirement Act,"
less "Contributions to Federal Retirement." [5]

For 1938 the sum of these figures was equal to –$17 million.[6] This figure (–$17 million) was added to the 1938 revised figure for "income paid out" (column 1) to give the revised 1938 figure for income payments (column 5).

For the years 1929 through 1937 the differences between "*revised* income payments" and "*revised* income paid out" were assumed to be the same as between the corresponding unrevised figures. These differences are shown in column (4); by adding these figures to those of "revised income paid out" (column 1) the *revised* estimates of income payments were obtained (column 5).

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[1] See Appendix VIII, pp. 49-50.

[2] Robert R. Nathan, "Income in the United States, 1929-1937," a bulletin of the United States Department of Commerce, November, 1938.

[3] Robert R. Nathan, "National Income in 1938 at 64 Billion Dollars," *Survey of Current Business*, June, 1939. After this report had been drafted, revisions in the income payment series were published by the United States Department of Commerce, *Survey of Current Business*, October, 1939.

[4] See the sources referred to in footnotes a and c of Table A–3.

[5] See Cone, "Revised Estimates of Monthly Income Payments in the United States, 1929-1938", *Survey of Current Business*, October, 1938, p. 15.

[6] This figure was obtained in the following manner:

In the source referred to in footnote 3 "employer contributions under the Social Security Act" were given as $1,119 million for 1938. "Employee contributions under the Social Security Act" for 1938 were assumed to be the same proportion of "Employer contributions" as in 1937. "Contributions to Federal Retirement" were assumed to be $80 million; they had been $78 million in 1936, and $80 million in 1937 (See Cone, *ibid.*). Similarly "Employee contributions to Railroad Retirement Fund" were assumed to be $60 million; they had been $61 million in 1937 (See Cone, *ibid.*). "Annuities and refunds to Federal employees" was assumed to be $60 million, or approximately equal to the 1936 and 1937 figures of $58 million and $61 million respectively (See Cone, *ibid.*).

By adding monthly figures in the *Survey of Current Business*, Mar., 1939, p. 19, "Direct relief payments" were estimated at $1,067 million, "Benefit payments under Social Security Act" at $503 million and "Veterans' compensation" zero.

TABLE A-3.—*Revision of United States Department of Commerce Figures for National Income Payments for Their June 1939 Revisions of National Income Paid Out, 1929–1938*

[Millions of dollars]

Year	National Income Paid Out		National Income Payments, Unrevised [3]	Unrevised National Income Payments Less Unrevised National Income Paid Out [4]	Revised National Income Payments [5]
	Revised [1]	Unrevised [2]			
	(1)	(2)	(3)	(4)	(5)
1929	80, 243	78, 556	78, 574	18	80, 261
1930	74, 414	73, 290	73, 350	60	74, 474
1931	62, 763	62, 032	63, 117	1, 085	63, 848
1932	49, 296	49, 024	49, 597	573	49, 869
1933	45, 565	45, 317	45, 921	604	46, 169
1934	52, 057	51, 510	52, 223	713	52, 770
1935	55, 814	55, 137	56, 086	949	56, 763
1936	64, 207	62, 586	64, 365	1, 779	65, 986
1937	70, 694	69, 330	68, 971	−359	70, 335
1938	65, 021	------------	64, 196	−17	65, 004

Sources:

[1] Robert R. Nathan, "National Income in 1938 at 64 Billion Dollars," *Survey of Current Business*, June, 1939, p. 12.

[2] Robert R. Nathan, "Income in the United States, 1929–1937," a bulletin of the United States Department of Commerce, November, 1938, p. 22.

[3] The figures for 1929 to 1935 are the sums of monthly figures shown in the source referred to in footnote [2]. The figures for 1936 and 1937 are from Frederick M. Cone, "Revised Estimates of Monthly Income Payments in the United States, 1929 to 1938," *Survey of Current Business*, October, 1938, p. 15. The figure for 1938 is the sum of monthly figures in the *Survey of Current Business*, March, 1939, p. 19.

[4] Column (3) minus column (2).

[5] Column (1) plus column (4).

Appendix IV. Computation of Supernumerary Income

Details of the calculation of supernumerary income are shown below in Table A–4. See also Appendix VIII, pp. 50–51.

Table A–4.—*Calculation of Supernumerary Income*, 1919–1938

Year	Kuznets' Aggregate income Payments to Individuals [1] (billions of current dollars)	United States Department of Commerce Income Payments [2] (billions of current dollars)	Consumers' Income [3] (billions of current dollars)	National Industrial Conference Board, Index of the Cost of Living [4] (Mar., 1935=100.)	Minimum Cost of Living Per Person [5] (current dollars)	Bureau of the Census Mid-Year Population Estimate for the United States [6] (thousands of persons)	Total Income Required for Minimum Cost of Living [7] (billions of dollars)	Supernumerary Income [8] (billions of dollars)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1919	$57.499	----------	$57.826	124.8	$281.8	105,003	$29.59	$28 2
1920	67.056	----------	67.437	144.1	325.4	106,543	34.67	32.8
1921	55.177	----------	55.490	124.8	281.8	108,208	30.49	25.0
1922	58.041	----------	58.371	118.8	268.3	109,873	29.48	28.9
1923	65.854	----------	66.228	122.0	275.5	111,537	30.73	35.5
1924	66.763	----------	67.142	123.5	278.9	113,202	31.57	35.6
1925	69.921	----------	70.318	126.5	285.7	114,867	32.82	37.5
1926	72.823	----------	73.237	127.2	287.2	116,532	33.47	39.8
1927	73.381	----------	73.798	124.4	280.9	118,197	33.20	40.6
1928	75.823	----------	76.254	122.7	277.1	119,862	33.21	43.0
1929	79.808	$80.261	80.261	122.1	275.7	121,526	33.50	46.8
1930	----------	74.474	74.474	117.9	266.2	123,091	32.77	41.7
1931	----------	63.848	63.848	106.3	240.0	124,113	29.79	34.1
1932	----------	49.869	49.869	95.0	214.5	124,974	26.81	23.1
1933	----------	46.169	46.169	91.3	206.2	125,770	25.93	20.2
1934	----------	52.770	52.770	96.8	218.6	126,626	27.68	25.1
1935	----------	56.763	56.763	100.7	227.4	127,521	29.00	27.8
1936	----------	65.986	65.986	103.4	233.5	128,429	29.99	36.0
1937	----------	70.335	70.335	107.9	243.7	129,257	31.50	38.8
1938	----------	65.004	65.004	105.4	238.0	130,215	30.99	34.0

[1] Simon Kuznets, *National Income and Capital Formotion, 1919–1935*, National Bureau of Economic research, 1937, p. 24, row 10.

[2] These are the revisions of the United States Department of Commerce series for "monthly income payments." See Appendix III, Table A–3, column 5.

[3] The figures for 1919 to 1928 are column (1) times 1.00568; the figures for 1929 to 1938 are the same as those of column (2). The figures for 1919 to 1928 are the result of linking the figures in column (1) to those of column (2) at 1929. That is, the figures in column (1) have been multiplied by the ratio of the 1929 figure of column (2) to the 1929 figure of column (1). In so doing it was assumed that:

(1) The 1929 figure of column (2) was the correct figure for consumers' cash income.

(2) That Kuznets' figures for 1919 to 1928 were "in error" in the ratio of his 1929 figure to that of column (2).

[4] For the years 1919 to 1937 see *Survey of Current Business, 1938 Supplement*, p. 11. The 1938 figure in the average of monthly figures for 1938 reported in *Survey of Current Business*, Mar., 1939, p. 20. The base of these figures has been shifted from 1923=100 to Mar., 1935=100.

[5] Obtained by multiplying column (4) by $2.2582 (or by dividing column (4) by 100 and multiplying by $225.82). Essentially what has been done is to assume that the necessity or minimum cost of living per person in March, 1935, was $225.82 (Appendix VIII, p. 51) and that it varied as did the National Industrial Conference Board index of the cost of living.

[6] United States Department of Commerce, Bureau of the Census. *Statistical Abstract of the United States, 1938*, p. 10.

[7] Column (5) multiplied by column (6).

[8] Column (7) subtracted from column (3). The resulting figure is the estimate of supernumerary income, or the amount of cash income available for disposal in the luxury goods market.

Appendix V. Estimation of Industrial Profits

For the years 1919 to 1937 the basic sources of data used in computing industrial profits were the *Statistics of Income* reports of the United States Bureau of Internal Revenue. The formula used in computing industrial profits is given in Appendix VIII. Table A–5 shows the details of the computations.

TABLE A-5.—*Industrial Profits Estimated From the Statistics of Income, 1919–1937**

[Thousands of dollars]

Year	Statutory Net Income [1] (1)	Total Federal Tax [2] (2)	Tax Exempt Interest [3] (3)	Dividends Received From Domestic Corporations [4] (4)	Industrial Profits [5] (5)
1919	$8,415,872	$2,175,342	$178,548		$6,419,078
1920	5,873,231	1,625,235	219,977		4,467,973
1921	457,829	701,576	188,789		−54,958
1922	4,770,035	783,776	394,042		4,380,301
1923	6,307,974	937,106	496,202		5,867,070
1924	5,362,726	881,550	517,209		4,998,385
1925	7,621,056	1,170,331	519,846		6,970,571
1926	7,504,693	1,229,797	499,592		6,774,488
1927	6,510,145	1,130,674	500,826		5,880,297
1928	8,226,617	1,184,142	523,458		7,565,933
1929	8,739,758	1,193,436	536,697		8,083,019
1930	1,551,218	711,704	526,261		1,365,775
1931	−3,287,545	398,994	541,713		−3,144,826
1932	−5,643,574	285,576	554,250		−5,374,900
1933	−2,547,367	423,068	591,586		−2,378,849
1934	94,170	596,048	658,701		156,823
1935	1,695,949	735,125	713,546		1,674,370
1936	7,326,217	1,191,378	444,669	$2,676,598	3,902,910
1937	7,354,003	1,276,184	476,302	2,682,227	3,871,894

Sources:
[1] *Statistics of Income for 1936*, Pt. II, p. 47, from column headed "Net income less deficit."
[2] *Ibid.*, column headed "Total Tax".
[3] Obtained from Mr. Edward White, Chief of the Statistical Section of the United States Bureau of Internal Revenue, in a letter of July 14, 1939.
[4] *Statistics of Income for 1936*, Pt. II, p. 24, from column headed "Aggregate".
[5] The sum of column (1) plus column (3) minus the sum of column (2) plus column (4).

* 1937 figures were taken from a preliminary release (Press Service, No. 18-55) of the United States Treasury Department, August 23, 1939.

At the time the statistical computations for this paper were made, the above figures for 1937 were not available, so that the 1937 figure for profits, as well as that for 1938 had to be estimated from other less accurate sources. The profits figures reported periodically by the National City Bank of New York in its monthly economic bulletin were used for this purpose.[1] These profit figures cover reports of about 2,000 corporations, and show profits after depreciation, interest, taxes, and other charges, but before dividends.

The general procedure used is as follows:

A. Estimating Profits for 1937:

(1) In its April 1, 1938, bulletin the National City Bank reported profit figures for 1936 and 1937 for 2,300 corporations grouped by types of business. These groups were then re-grouped into business classes comparable to those used in the *Statistics of Income for 1936*.

(2) The ratio of the profit figure for 1936 for any group computed from the *Statistics of Income* to that reported by the National City Bank was then computed.

(3) The 1937 profit figure for that group as reported by the National City Bank was then multiplied by this ratio, giving estimated profits for 1937 for this group.

(4) The sum of all such estimated group profits was the estimated figure for industrial profits for 1937.

It is interesting to note that the resulting estimate of $3.96 billion is only about 2 percent larger than the profit figure reported by the United States Bureau of Internal Revenue for 1937. (See Table A-5.)

B. Estimating Profits for 1938:

(1) In its April 1, 1939, bulletin the National City Bank reported profits for 1937 and 1938 for a group of over 2,400 corporations. These corporations were grouped into classes corresponding to those used in estimating profits for 1937.

[1] See the economic bulletins of the National City Bank of New York for April 1, 1938, and April 1, 1939

(2) Since the report for April 1, 1939, did not cover exactly the same corporations as that for April 1, 1938, the group totals for 1937 of the 1939 report differed from those of the 1938 report. Thus for each group the ratio of the 1937 profit figure shown in the 1938 report to that in the 1939 report was computed. The 1938 figure for this group was then multiplied by this ratio.

(3) The resulting group figure was then multiplied by the ratio computed in step (2) of (A), giving estimated 1938 profits for that group.

(4) The sum of these group profit figures was the estimate of industrial profits for 1938.

The estimated profits figures for 1937 and 1938 were (in billions):

1937	\$3. 959
1938	\$2. 165

These were the figures actually used in the computations.

Appendix VI. Computation of Industrial Production Index

It was decided that the index of industrial output most suitable for the purposes of this paper was the Federai Reserve Board's *Index of Manufacturing Production* with the iron and steel production subgroup removed.[1]

The Federal Reserve Board index is an aggregative type index with fixed weights. The base of the index is 1923–25=100.

The procedure for removing the iron and steel subgroup was as follows:

Let $q_1, q_2, \ldots, q_I, \ldots, q_N$, represent the quantity of output of the various products included in the index; qI is the output of iron and steel;

and $w_1, w_2, \ldots, w_I \ldots, w_N$ are the corresponding fixed weights.

Thus the value of the index of manufacturing output in any year, D, is:

(1) $$M_D = \frac{\sum_{i=1}^{N} q_i^D w_i}{\frac{1}{3}\sum_{i=1}^{N} w_i(q_i^{1923}+q_i^{1924}+q_i^{1925})} \times 100$$

where q_i^D is the output of the item i in the year D, and $\frac{1}{3}(q_i^{1923}+q_i^{1924}+q_i^{1925})$ is the average output of the item i for the three base period years, 1923 to 1925.

Similarly, the value of the output index for the iron and steel subgroup for any year D is

(2) $$I_D = \frac{q_I^D w_I}{\frac{1}{3} w_I(q_I^{1923}+q_I^{1924}+q_I^{1925})} \times 100$$

Thus the value of the index of manufacturing output with the iron and steel subgroup removed for any year D is:

(3) $$M_D' = \frac{100\left(\sum_{i=1}^{N} q_i^D w_i\right) - q_I^D w_I \times 100}{\left(\frac{1}{3}\sum_{i=1}^{N} w_i(q_i^{1923}+q_i^{1924}+q_i^{1925})\right) - \frac{1}{3} w_I(q_I^{1923}+q_I^{1924}+q_I^{1925})}$$

Formula (3) may be rewritten:

(4) $$M_D' = \frac{M_D \times \frac{1}{3}\sum_{i=1}^{N} w_i(q_i^{1923}+q_i^{1924}+q_i^{1925}) - I_D \times \frac{1}{3} w_I(q_I^{1923}+q_I^{1924}+q_I^{1925})}{\left(\frac{1}{3}\sum_{i=1}^{N} w_i(q_i^{1923}+q_i^{1924}+q_i^{1925})\right) - \frac{1}{3} w_I(q_I^{1923}+q_I^{1924}+q_I^{1925})}$$

[1] For a description of the Federal Reserve Board's indexes of production see the mimeographed release of the Division of Research and Statistics, Federal Reserve Board, "Federal Reserve Index of Industrial Production," reprinted from the *Federal Reserve Bulletin* for February and March, 1927, with notes on subsequent revisions. (Release dated Nov., 1937.)

The value of $\frac{1}{3}\sum_{i=1}^{N} w_i\ (q_i^{1923}+q_i^{1924}+q_i^{1925})=60{,}639{,}571$ and the value of $\frac{1}{3}\ w_I\ (q_I^{1923}+q_I^{1924}+q_I^{1925})=13{,}937{,}195$.[2]

Thus formula (4) may be written:

$$(5) \qquad M_D'=\frac{M_D\times(0.060640)-I_D\times(0.013937)}{0.046703}$$

where 0.046703 is equal to $\frac{60{,}639{,}571-13{,}937{,}195}{1{,}000{,}000{,}000}$

The details of the computation are shown below in Table A–6.

TABLE A–6.—*Computation of Federal Reserve Board Index of Manufacturing Production Excluding Iron and Steel, 1919–1938*

[1923–1925=100]

Year	M (1)	Mx 0.060640 (2)	I (3)	Ix 0.013937 (4)	(2)−(4) (5)	M (5)X 0.046703 (6)
1919	84	5.094	82	1.143	3.951	85
1920	87	5.276	99	1.380	3.896	83
1921	67	4.063	46	0.641	3.422	73
1922	86	5.215	82	1.143	4.072	87
1923	101	6.125	105	1.464	4.661	100
1924	94	5.700	89	1.241	4.459	95
1925	105	6.367	106	1.478	4.889	105
1926	108	6.549	113	1.575	4.974	107
1927	106	6.428	104	1.450	5.978	107
1928	112	6.792	119	1.659	5.133	110
1929	119	7.216	130	1.812	5.404	116
1930	95	5.761	94	1.310	4.451	95
1931	80	4.851	60	0.836	4.015	86
1932	63	3.820	31	0.432	3.388	73
1933	75	4.548	53	0.739	3.809	82
1934	78	4.730	60	0.836	3.894	83
1935	90	5.458	79	1.101	4.357	93
1936	105	6.367	110	1.533	4.834	104
1937	109	6.610	118	1.645	4.965	106
1938	84	5.094	66	0.920	4.174	89

Sources:

Col. (1): Federal Reserve Index of Production: Manufactures. See footnote 2 in text.
Col. (2): Column (1) multiplied by 0.060640.
Col. (3): The subgroup index for iron and steel production. See footnote 2 in text.
Col. (4): Column (3) multiplied by 0.013937.
Col. (5): Column (2) minus column (4).
Col. (6): Index of Production: Manufactures excluding iron and steel.

APPENDIX VII.—DEMAND RELATION EQUATIONS

Let x_p denote the quantity of production of steel ingots and castings (in thousands of gross tons),
x_b, the quantity of steel bookings (in thousands of gross and net tons),
x_s, the quantity of steel shipments (in thousands of gross and net tons),
p, the *Iron Age* composite price of finished steel (in cents per pound),
I, the index of industrial production excluding iron and steel (1923–1925=100),
I_r, the link relatives of I,
S, supernumerary income (in billions of dollars),
P, industrial profits (in billions of dollars),
and t, Time (in years measured from an origin depending on the period studied).

[2] These figures were obtained from Mr. F. A. Goldenweiser, Director of Research and Statistics, of the Division of Research and Statistics of the Board of Governors of the Federal Reserve System in a letter dated June 29, 1939.

Then the four relations stated on page 24 may be stated mathematically in the form:

Relation I: $x_p = a_p + b_p p + c_p I + d_p t$
Relation II: $x_p = e_p + f_p p + g_p I + h_p I_r$
Relation III: $x_s = a_s + b_s p + c_s S + d_s P + e_s t$
Relation IV: $x_b = a_b + b_b p + c_b s + d_b P + e_b t$

A fifth relation also was studied.

Relation V: $x_p = Ap^B I^C 10^{Dt}$

The various constants, a_p, b_p, etc., were determined by the method of least squares. The resulting statistical demand relations are shown below in Table A-7.

TABLE A-7.—*Equations of Demand Relations*

Period Studied	Relation Number	Equation of Demand Relation
1919–1938 [1]	I	$x_p = -63{,}800 + 7{,}478\,p + 893\,I - 91.1\,t$
1919–1938 [2]	I	$x_p = -65{,}200 + 8{,}201\,p + 890\,I$
*1922–1938 [3]	I	$x_p = -57{,}081 + 2{,}217\,p + 944\,I - 127\,t$
*1920–1938	II	$x_p = -71{,}700 + 8{,}605\,p + 857\,I + 87\,I_r$
1919–1938 [4]	III	$x_s = 3{,}014 + 388\,p + 1{,}005\,P + 510\,S + 144\,t$
*1922–1938 [4]	III	$x_s = 11{,}760 - 2{,}419\,p + 1{,}157\,P + 426\,S + 59\,t$
1919–1938 [4]	IV	$x_b = 8{,}680 + 298\,p + 1{,}563\,P + 327\,S + 270\,t$
*1922–1938 [4]	IV	$x_b = 33{,}480 - 10{,}254\,p + 1{,}863\,P + 258\,S + 143\,t$
1922–1938 [4]	V	$x_p = \dfrac{0.158\,p^{0.235}\,I^{2.667}}{10^{0.0020t}}$

[1] Origin of time variable is January 1, 1929.
[2] Time variable has been excluded in the equation.
[3] Origin of time variable is January 1, 1929.
[4] Origin of time variable is July 1, 1930.
*Equations used in text Tables 1 and 2.

Given these equations, it is a simple task to measure the elasticity of demand, or the elasticity of the quantity of steel sold with respect to the price of steel. Let x_c be the quantity of steel sold *as computed from* one of the above equations. Then the elasticity of demand is equal to $\dfrac{\partial x_c}{\partial p} \cdot \dfrac{p}{x_c}$. Thus the elasticity of demand formula for the first of the above equations is (where e denotes elasticity of demand):

$$e = \frac{7{,}478\,p}{-63{,}800 + 7{,}478\,p + 893\,I - 91.1\,t} \qquad \text{(a)}$$

The elasticity formulae for the other equations are similarly defined, except for Relation V, which is directly

$$e = 0.235$$

It is obvious therefore that, with the exception of Relation V, the elasticity is not constant, but varies with the factors influencing demand.

In Table 2, the elasticities were computed by substituting the *average* values of the demand factors in equations such as that above.

APPENDIX VIII. DEFINITION AND MEASUREMENT OF THE ECONOMIC VARIABLES USED

(1) *The Quantity of Steel Sold.*—The "quantity of steel sold" has been defined on a previous page [1] as the quantity of steel sold by steel producers. There are two major problems in the measurement of the quantity of steel sold:

(a) No reliable data are available showing for the country as a whole the physical quantity of steel sold, either as a gross figure or by separate types of steel.

(b) As was emphasized in section III-A, even if sales figures for the separate types of steel were available, there would still remain the problem of combining them into an economically logical composite representing the total

[1] See *supra*, p. 11.

physical volume of sales. It should be obvious that the various types of steel do not have the same economic importance (in a demand analysis) *per pound*. Furthermore, the demand conditions for the different types of steel need not (and, in general will not) be the same. Moreover, the types of steel tend to change in character from year to year. The problem of finding some common unit by which *different* items could be aggregated is one for which a thoroughly satisfactory solution has never been reached.[2] In the absence of an answer to the problem, the only recourse is to adopt the usual aggregating procedures used in making index numbers. It seems doubtful that this will result in damagingly spurious information.

Six sets of data have been considered here in estimating the quantity of steel sold.

(i) *Production of steel ingots and castings in the United States* as reported by the American Iron and Steel Institute.[3] These figures have the advantage, as a proxy measure of the quantity of steel sold, of representing almost complete coverage of the production of steel ingots and castings in the United States. The main disadvantage is that steel ingot *production* at best can represent only finished steel *production* and not finished steel *sales*. Sales differ from production by the amount of the net change in inventories of steel in the hands of steel producers. At times of rapid economic change, the fluctuations of these inventories are probably substantial enough seriously to invalidate the use of production figures. Since there are no complete or reliable figures available showing the net change in steel inventories in the hands of producers, no adjustments can be made in the production figures.

(ii) *Production of hot-rolled iron and steel in the United States.* These figures are reported by the American Iron and Steel Institute both as a total figure in gross tons, and by separate gross-ton totals for about twenty different types of hot-rolled iron and steel.[4] The advantages of these figures are

(a) They represent practically complete coverage of hot-rolled iron and steel production in the United States.

(b) They are more nearly representative of finished steel than ingot production figures.[5]

(c) The breakdown into separate types makes it possible to weight the various types and thus obtain a more logical measure of finished steel output. However, these figures have the same disadvantage as steel ingot production figures, namely, that they are production and not sales figures, and thus will be in error by the amount of net change in hot-rolled iron and steel inventories in the hands of steel producers.

(iii) *Index of Production: Steel Works and Rolling Mills* computed by the National Research Project of the Works Progress Administration.[6] The main advantage of the series is that an attempt was made to combine the different types of steel on the basis of a measure of their economic importance. The series, however, has two substantial disadvantages:

(a) The production composite was computed for use in a study of labor productivity in the steel industry. Thus the economic weights used—although perhaps satisfactory for a productivity study—have practically no relation to the economic importance of the different types of steel from the point of view of steel demand analysis.

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[2] See, for example, the excellent discussion in J. D. Black and B. D. Mudgett, *Research in Agricultural Index Numbers*, (Social Science Research Council, Bulletin 10) 1938, and the sources quoted therein.

[3] American Iron and Steel Institute, *Annual Statistical Report for 1938*, 1939, p. 15. These figures are reported in total and by types on a gross ton basis. Five types of steel ingots are included (basic and acid open-hearth, bessemer, electric, and crucible). In 1934 and subsequent years the total for steel ingots and castings included only that portion of the production of steel for castings used by foundries operated by companies producing steel ingots.

Figures comparable to those of the American Iron and Steel Institute were also available for the United States Steel Corporation.

[4] American Iron and Steel Institute, *Annual Statistical Report for 1938*, pp. 21-23, and *Annual Statistical Report for 1937*, p. 22.

The following classification of hot-rolled iron and steel is made: plates; sheets; strip; black plate; hoops; cotton ties and baling bands; merchant bars; concrete bars; structural shapes; sheet piling; rails; long splice bars and tie-plate bars; skelp; wire rods; rolled forging billets; cross ties; blooms, billets, etc., for export; strip and sheets for cold-reduced black plate and tin-plate (separate classification only for 1938); blanks or pierced billets for seamless tubes (separate classification beginning in 1926); rolled steel car wheels (separate classification beginning in 1931); and all other. Inasmuch as production of hot-rolled iron amounts (in most years, 1919 to 1938) to less than 3 or 4 percent of the total, and since its fluctuations correspond closely to those of hot-rolled steel, the above figures are very close approximations of hot-rolled steel production. There is a separate *total* for hot-rolled *steel* production, but no breakdown into separate types of products.

[5] In fact, a large proportion of the finished steel sold is hot-rolled steel.

[6] Works Progress Administration, National Research Project, *Production, Employment, and Productivity in 59 Manufacturing Industries* (Report No. S-1), Pt. II, May, 1939, pp. 92-100. A detailed description of the methods used in constructing the index is given.

(b) They are production and not sales figures.

(iv) *Estimates of finished steel shipments* by *The Iron Age* and *Steel*, two leading steel trade journals.[7] In each case the estimates are based on reports from steel producers. The estimates purport to show the total volume of shipments of finished steel by separate types of steel to major consuming industries. Although these estimates have the obvious advantages:

(a) The breakdown of the total into subtotals by separate types of steel and by consuming industries makes possible the computation of a logical economic composite measure,

(b) They are estimates of *sales* of finished steel and not of *production* of steel,

their unreliability was too great to warrant using them. The coverage of the series was low until recently, and varied considerably from year to year. Moreover, the classification of types of steel and consuming industries was not the same from year to year so that it was difficult to make use of the sub-group totals.

(v) *United States Steel Corporation subsidiaries' domestic shipments of rolled and finished steel products.* Inasmuch as steel production and sales of the United States Steel Corporation subsidiaries have since 1919 comprised one-third to one-half of the total for the country as a whole it was thought possible to estimate the nation's sales from those of the Corporation subsidiaries. The series have the obvious disadvantage that they represent only sales of the United States Steel Corporation. Although the types of steel sold by the Corporation do not represent exactly the composite type for the industry as a whole, and though the conditions of demand for the United States Steel Corporation subsidiaries are not identical to those for the industry it was decided that these disadvantages were not great enough to preclude use of the figures. The series does have several important advantages.

(a) Its coverage is reasonably well defined in relation to the industry as a whole.

(b) Only *domestic* shipments are included. Thus no adjustment for exports is needed.

(c) The figures represent sales and not production.

(vi) *United States Steel Corporation subsidiaries' domestic customers' bookings of rolled and finished steel products.* These data consist of all domestic contracts for tonnage. They have the same disadvantages as the above shipment figures, but they do have one important advantage over the shipment figures. Since there is some lag between the time an order (booking) is placed and the time shipment is made,[8] the shipment figures do not coincide in time with the demand conditions under which the order is placed and the sale made.

It was finally decided that three of the above six sets of data would not prove useful in estimating the quantity of steel sold:

(a) *The Iron Age* and *Steel* estimates of finished steel shipments, because they were considered too unreliable.

(b) The W. P. A. National Research Project index of steel works output because it was a *production* index, and because its construction was not deemed suitable for a demand study.

(c) Production of hot-rolled iron and steel, because it followed steel ingot production so closely [9] that it possessed no great advantage over the latter.[10]

Three separate estimates of the quantity of steel sold were used for further experimentation:

(a) The American Iron and Steel Institute figures on production of steel ingots and castings were used directly as representing sales. These figures were considered as the least satisfactory of the three estimates. However, it was decided to use them because of their greater familiarity.

[7] In connection with this section see the detailed discussion in the memorandum of M. W. Worthing, "Distribution of Steel Products to Major Consuming Industries," United States Steel Corporation, October 30, 1939.

[8] This lag varies greatly with the rate of operations and the order backlog of steel producers. For example at the peak of the boom in 1937 shipments on some products were delayed for as much as six to seven months after the placing of the order

[9] The year to year fluctuations in steel ingot production were almost identical to those of hot-rolled iron and steel production except for a long-run smooth trend increase in the ratio of the former to the latter. See chart A.

[10] Preliminary experimentation indicated that no improvement would be made by computing a composite measure in which the different types of hot-rolled iron and steel were given weights corresponding to their respective prices.

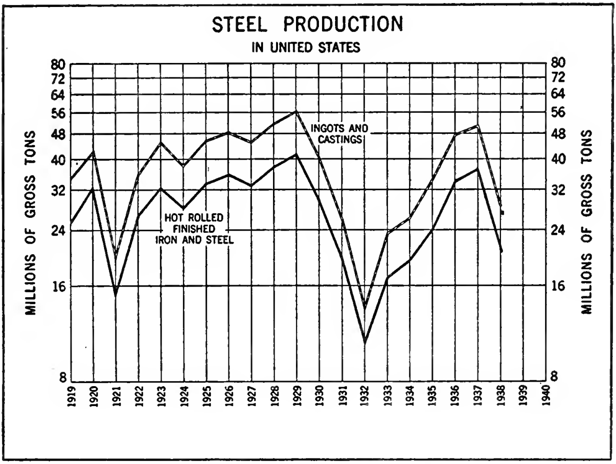
(b) A second estimate was based on the United States Steel Corporation subsidiaries' figures for total shipments of rolled and finished steel. The estimate was made in the following simple manner. It was assumed that for any year the ratio of the Corporation subsidiaries' shipments to those of the industry as a whole was the same as the ratio of the Corporation subsidiaries' production of steel ingots and castings to that for the industry. Estimated total shipments were thus obtained by dividing the Corporation subsidiaries' total shipments by the latter of the above two ratios.

This procedure was justified on these grounds:

(i) There is very little time lag between ingot production and actual shipment.

(ii) It seemed reasonable to believe that the Corporation subsidiaries weight losses (conversion losses) involved in converting steel ingots into finished steel were not substantially different from those for the industry as a whole, or, at least, that the ratio of the Corporation subsidiaries' weight losses to those of the industry did not change sharply from year to year.

CHART A



(iii) The ratio of the Corporation subsidiaries' steel ingot production to that of the industry was almost constant except for a smooth long run decline.

(c) A third estimate was based on the United States Steel Corporation subsidiaries' figures for domestic bookings of rolled and finished steel.

The method of adjusting this series was the same as that used for the Corporation subsidiaries' shipments.

The above three estimates are shown on Chart 1, page 21, and in Appendix I, Table A-1. The details of the estimations of bookings and shipments are shown in Appendix II.

(2) *The Price of Steel.*—The difficulties of defining and measuring the price of steel were indicated in sections III-A, and III-F:

(a) There are many different kinds of finished steel sold, and each kind has its own price. Thus there is a problem similar to that encountered in defining and measuring the quantity of steel sold. How should the different types be combined in order to obtain an economically logical measure of the

price of steel? No absolutely conclusive answer to this question has ever been given.[11] However, since the prices of the different types of steel move more or less closely together a fairly satisfactory solution can be obtained by one of the well known averaging methods used in constructing price index numbers.

(b) Prices tend to be different in different geographical regions. The problem here is essentially the same as the first.

(c) Because of price concessions, published prices—which are the only source of price data—do not always reflect the actual prices paid by steel buyers.

There are three well known series computed for the composite price of finished steel:

(i) That computed by *Iron Age.*
(ii) That computed by *Steel.*
(iii) That computed by the *American Metal Market.*

(i) The *Iron Age* Composite Price of Finished Steel is published weekly in *Iron Age.*[12] The *Iron Age* composite is a simple unweighted arithmetic average of the following items: bars, plates, shapes, hot-rolled strip, plain wire, heavy rails, black pipe, and No. 10 gage hot-rolled sheets.[13] The prices used in each case are the *Iron Age* weekly market quotations of base prices at Pittsburgh.[14] The quotations are based on the *Iron Age* estimate as to what is the "open market price." [15]

(ii) *Steel's* composite price of finished steel is based on weekly steel price quotations as reported by *Steel.* The composite is a simple unweighted arithmetic average of the prices at Pittsburgh of the following items: plates, shapes, bars, wide hot-rolled strip, wire nails, plain wire, tin plate, black pipe, No. 24 gage hot-rolled sheets, and No. 24 gage galvanized sheets.[16] The weekly quotations on which the composite is based represent the best judgment of the editors of *Steel* as to the going market prices.[17]

(iii) The *American Metal Market* composite price of finished steel is based on daily price quotations published in the *American Metal Market.*[18] The composite is a weighted arithmetic average of the following finished steel products: bars, plates, shapes, pipe, wire nails, No. 24 gage sheets, strips, and tin-plate.[19]

The three composites are so similar in their movements as to make a choice between them unimportant. The *Iron Age* composite price was

[11] J. D. Black and B. D. Mudgett, *op. cit.* See footnote 2 of this appendix.

[12] Annual and monthly averages for the years 1903 to 1938 are given in the *Iron Age*, Jan. 5, 1939, pp 198–199.

[13] Hot-rolled strip was not included prior to 1920. Before 1920 No. 24 gage hot-rolled annealed sheets is used instead of No. 10 gage hot-rolled sheets. (Information from letter cited in footnote 15.)

[14] Although steel prices vary from one geographical area to another (see section III–F.), the year to year fluctuations in all areas tend to be more or less the same. Thus it is doubtful if there is any serious unrepresentativeness in a composite based on Pittsburgh prices.

[15] Mr. C. E. Wright, Managing Editor of *Iron Age*, in a letter dated April 5, 1939, writes: "We do not change our base prices unless we feel that such a change has become more or less general. For example, when a break in sheet prices occurred in October, 1938, we did not reduce our base price on the first news that a concession had been made to one or two companies, but the following week, however, this concession had become general. That is, all companies were making it to all customers, and therefore it became an open market price."

[16] This description of the *Steel* composite price was obtained from Mr. G. H. Manlove, Associate Editor of *Steel* in a letter dated April 12, 1939. Prior to July, 1938, the price of No. 28 gage rather than of No. 24 gage galvanized sheets was used in the composite. After April, 1938, the editors of *Steel* added an extra of 90 cents to the quotation for No. 24 hot-rolled sheets. Annual and monthly figures for the composite for the years 1927 to 1938 are given in *Steel*, Jan. 2, 1939, p. 251.

[17] Mr. Manlove writes: . . "the quoted prices are the best judgment of the editors [of *Steel*], although in the present market procedure with prices announced by quarters, there is comparatively little variation from the published figures."

[18] Annual figures from 1899 to 1937, and monthly figures for the years 1914 to 1937 are shown in *Metal Statistics for 1938*, published by the American Metal Market Company, 1939, pp. 85–88. Recent figures can be obtained from current issues of the *American Metal Market*, metal trades daily paper.

[19] The weights are as follows:

Aars	2.0
Plates	1.5
Shapes	1.0
Pipe (1–3)	1.5
Wire nails	1.0
Sheets	1.5
Strips	1.0
Tin plate	0.5
Total	10.0

These weights are rough estimates of the "relative importance" of the different items. Prior to Mar. 29, 1933, another system of weights was used. See *Metal Statistics for 1938*, p. 85, and for 1932, p. 21.

selected for use in the statistical analysis because it was the most widely known of the three.

(3) *Consumers' Cash Income.*[20]—The measure of consumer income which seemed most appropriate for the purpose of this paper, was one measuring the actual amount of cash income received by consumers and disposable by them for consumers' goods and services. The two basic series which most closely approximate this ideal measure are:

(a) The United States Department of Commerce series for "national income payments." [21]

(b) The National Bureau of Economic Research series for "aggregate income payments to individuals" (basic variant).[22]

Neither of these series is completely appropriate; both include payment items not actually received by consumers and exclude certain other items that are received by consumers.[23] However, both series are reasonably good estimates of cash payments to consumers.

Inasmuch as the United States Department of Commerce series does not go back beyond 1929, the National Bureau of Economic Research estimates were used for the years 1919 to 1928. The latter series was linked to the former at 1929.[24]

(4) *The Cost of Living.*[25]—The majority of consumers' products-made-from-steel—of which the passenger automobile is most important—are luxury goods which can be thought of as being purchased with that part of consumers' cash income remaining after the necessary or subsistence costs of living have been paid. It is obviously unrealistic—as well as difficult—to draw a hard and fast line at what can be called *subsistence* living costs, and to assume that only after such costs are met can the consumer begin buying luxury goods. But on the average some such relationship exists.

The subsistence costs of living per person were taken as $225.82 for the month of March, 1935. This is equivalent to the $903.27 which the Works Progress Administration set up as the minimum costs of living for a family of four in March, 1935.[26] For other periods the subsistence costs of living were assumed to vary from this level as did the National Industrial Conference Board index of the cost of living vary from its March, 1935, level.[27] After computing subsistence costs of living for the country as a whole, subsistence living costs were subtracted from *consumers' cash income*, leaving *consumers' supernumerary income.*[28] Supernumerary income, or the amount of cash income disposable for luxury goods and services, was the income series used in the statistical analysis. The series is shown in Chart 1, and Appendix I.

(5) *Industrial Profits.*[29]—The basic sources of data on industrial profits are reports received by the United States Bureau of Internal Revenue from all companies filing Federal corporation income and excess profits tax returns and personal holding company returns. These reports are compiled and published annually in the Bureau's *Statistics of Income* reports.[30] The profit figures which were used in this study were based on these *Statistics of Income* reports,[31] and were computed from the following formula:

Industrial profits equal

Statutory net income [32]

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[20] In connection with this section see Roos and von Szeliski, *op. cit.*, pp. 39–41.

[21] Robert R. Nathan, "Income in the United States, 1929–37" (Bulletin of the United States Department of Commerce, Nov., 1938); "National Income in 1938 at 64 Billion Dollars," *Survey of Current Business*, June, 1939, p. 12; Frederick M. Cone, "Revised Estimates of Monthly Income Payments in the United States, 1929 to 1938", *Survey of Current Business*, October, 1938, p. 15.

[22] Simon Kuznets, *National Income and Capital Formation, 1919-1935*, National Bureau of Economic Research, 1937.

[23] See the discussions in the sources cited in footnotes 20 to 22.

[24] Certain revisions, however, were first made in the Department of Commerce series; see Appendix III.

[25] See Roos and von Szeliski, *op. cit.*, pp. 41–42.

[26] Works Progress Administration, Division of Social Research, "Intercity Differences in Costs of Living in March, 1935, 59 Cities" (Research Monograph XII).

[27] A detailed description of this index is presented in *The Cost of Living in the United States, 1914-1936*, pp. 13–42, published by the National Industrial Conference Board. Monthly and annual figures are reported in the *Survey of Current Business, 1938 Supplement*, p. 11, and current issues.

[28] The details of the computation of supernumerary income are given in Appendix IV.

[29] In connection with the discussion of this section see W. L. Crum. "Corporate Earnings on Invested Capital", *Harvard Business Review*, v. XVI, No. 3, pp. 336 to 350.

[30] United States Treasury Department, Bureau of Internal Revenue, *Statistics of Income for 1936*, 1939, Part II, and for previous years.

[31] The *Statistics of Income* reports represent almost complete coverage of business profits. The number of business concerns not filing returns under the various Federal revenue acts do a negligible proportion of the nation's business.

[32] *Statistics of Income for 1936*, p. 47. Statutory net income represents "net income less deficit." In other places it is called simply "net income"; see, for example, p. 24. For 1936 and 1937 statutory net income includes "dividends received from domestic corporations."

less The total federal tax [33]
plus Tax-exempt interest on government obligations [34]
less Dividends received from domestic corporations (for 1936 and 1937).[35]

What was desired was a series showing for any year the *real* (economic) profit situation, and thus the current real profit *outlook* of buyers of producers' products-made-from-steel. The above profit figures are subject to some severe limitations in this respect:

(a) Certain corporations included in the profit reports can be only of insignificant importance as buyers in the capital goods market. The most important of these groups is the group of "financial" institutions. Total profits of this group—and others not relevant to the capital goods market—however, are not a large enough proportion of the total, and do not vary enough from the general movement of profits to distort the figures seriously.

(b) A much more serious limitation is that the tax accounting procedures used by business tend to make their profit figures represent the profit situation and outlook of a period somewhat prior to that for which the figures are actually reported. The largest part of the receipts of business comes from sales of goods and services. These receipts are based on *current* sales prices more or less accurately reflecting *current* cost and demand conditions. However, since production must precede the date of sale, and since many of the costs of production are incurred at an even earlier date (purchase of raw materials, equipment, etc.), the cost of production figures used in profit calculations represent the cost situation of an earlier date. If costs and prices have in the meantime changed drastically, a substantial part of the profits or losses reported are what amounts to *inventory* and *capital* profits or losses. Thus the profit figures reported tend to lag behind the current cost and demand situation. The profit series used in this study is shown in Chart 1 and Appendix I.

(6) *Volume of Industrial Production.*—The most widely known and probably the best composite measure of the volume of industrial output is the Federal Reserve Board's index of industrial production.[36] However, it has a very serious limitation for the purposes of this study. What is desired is a measure of the industrial production of all commodities other than iron and steel (produced by steel producers). Iron and steel production is the most important single component of the Federal Reserve Board index, with a weight which gives it an aggregate importance of almost 25 percent of the total for the index.[37] Thus relationships observed between steel sales and this index would be in part spurious.

The detailed method of removing iron and steel production from the index is described in Appendix VI. The series with iron and steel production removed, which is the one used in the statistical analysis, is shown in Chart 1 and A pendix I.

EXHIBIT No. 1412

AN ANALYSIS OF CHANGES IN THE DEMAND FOR STEEL AND IN STEEL PRICES, 1936–1939

This is an analysis prepared by the Special Economic Research Section of United States Steel Corporation, composed of Messrs. Edward T. Dickinson, Jr., Ernest M. Doblin, H. Gregg Lewis, Jacob L. Mosak, Mandal R. Segal, Dwight B. Yntema and Miss Marion W. Worthing. The work of this group was under the supervision of Theodore O. Yntema, Professor of Statistics, University of Chicago. This analysis was written by H. Gregg Lewis, who had the benefit of suggestions from other members of the staff. It is issued by United States Steel Corporation.

NOVEMBER 1, 1939.

[33] The total federal tax includes the normal corporation income tax, war profits and excess profits taxes, and the surtax on undistributed profits. See *Statistics of Income for 1936*, p. 47.
[34] The amount of tax exempt interest on government obligations which is added to statutory net income is the amount of wholly tax-exempt interest. See *Statistics of Income for 1936*, pp. 6 and 24.
[35] In 1936 and 1937 "dividends received from domestic corporations" were included in statutory net income for excess profits tax computation. In order to avoid double counting of corporation earnings it was therefore removed. See footnote 32. The detailed computations of industrial profits are shown in Appendix V.
[36] A full description of the index and values of the index and its sub-groups back to 1919 may be obtained from the Division of Research and Statistics of the Federal Reserve Board, Washington, D. C. Current figures are reported in the Board's monthly *Federal Reserve Bulletin*, the *Survey of Current Business*, and numerous other places.
[37] See Appendix VI.

CONTENTS

I. Introduction

A substantial increase in the level of steel prices early in the spring of 1937 was followed shortly by a considerable decline in the volume of new orders of steel. In June, 1938 a drop in steel prices almost immediately preceded several months of rising sales by steel makers. Temporary bargain markets for certain steel products occurring in the autumn of 1938 and recently in May of this year were accompanied by temporary increases in steel purchases.

To the superficial observer, these events might indicate that reductions in the price of steel greatly increase the tonnage sales and revenues of steel producers, and conversely, that increases in the level of steel prices greatly reduce their volume of business and revenues.

The primary question which the analysis of the following pages will attempt to answer is this: How important was the *level* of steel prices in accounting for the fluctuations in the demand for steel that occurred in the 1936–39 period? In answering this question it will be necessary to examine the importance of other aspects of price behavior, as well as the importance of other factors which might account for the changes in demand.

II. Summary of Findings

An analysis of the period June 1936 to October 1939 leads to several conclusions with respect to the influence of steel prices on the quantities of steel demanded in the short run:

(1) Changes in the levels of steel buying during this period were largely determined by:

(a) the current and anticipated levels of business activity, income and profits;

(b) the expectations with respect to steel prices in the immediate future as compared with current steel prices;

(c) the volume of steel inventory accumulated in the immediate past; and

(d) the length of time required to fill new orders for steel.

(2) There is little evidence that the *actual level* of the buying price of steel—within rather wide limits—is of importance in explaining the actual level of steel buying, at least in the short run. That is to say, actual changes in the price of steel, *per se*—apart from their effect on buyers' expectations as to the magnitude and direction of future changes—are of minor importance in accounting for short run changes in the volume of steel purchases.

To illustrate, the reduction in new orders of steel following shortly after the price advances of March 1937, and the increase in new orders which came at about the same time as the price reductions of June 1938, can be more reasonably explained by factors other than changes in steel prices. The great increase in steel buying in September and October of 1939, which occurred without reduction in steel prices, further illustrates the dominant influence of factors other than price in the demand for steel.

(3) There is evidence, however, that widespread expectations that the level of steel prices is going to advance substantially in the near future due to rising labor and other costs, and that the advance will not be temporary, will generally lead to substantial increases in the present volume of steel buying. Such anticipations are strengthened if there have been price increases in the near past, and if feelings of price inflation and rising business activity are generally abroad in the economy. When the expectation becomes a certainty, as when a price increase is announced prior to its effective date, the effect will almost certainly be an increase in the level of buying from what it would otherwise have been.

A substantial part of the great increase in new orders that took place in the period November, 1936 to March, 1937 can be accounted for by such protective forward buying in advance of price increases which had been announced. This was especially true of the two months December, 1936 and March, 1937 when announcements of price increases resulted in a greatly increased volume of new orders.

(4) As a corollary to the above point, expectations of a stable level of prices following a period of price advances will tend to reduce the volume of buying. That is, anticipations of stable prices will tend to lead to a lower volume of buying than anticipations of rising prices. Thus the cessation of anticipated rising prices will in general be accompanied by a short run decline of purchases.

For example, the decline in orders in January and February, 1937, is partly explained by the fact that steel purchasers were relatively sure that steel prices would not advance much before April 1, 1937. Part of the decline in orders in the months following the price advances of March, 1937 can be similarly explained.

Conversely, expectations of stable prices following a period of falling prices tend to increase the volume of steel purchases.

(5) Anticipations of falling steel prices tend to reduce the amount of steel purchases in the short run.

(6) A reduction in steel prices that is expected to be temporary—that is, a temporary low price market for buyers—in general will cause a short run increase of buying. Cases in point are the increases in steel orders that took place in October, 1938, and again in May, 1939.

For the most part, the effect on the volume of steel buying of such price anticipation factors as have been discussed above is merely to cause a short run shift in the date of actual purchases, without changing the total amount bought over a twelve or eighteen months' period from what it otherwise would have been. This follows from the fact that the total steel requirements of steel purchasers over a twelve or eighteen months' period depend very largely on their current and expected output of products made from steel. Increases (or decreases) of their inventories of steel much beyond their expected production needs in the near future are both expensive and risky.

Thus, for example, short run heavy buying of steel in advance of expected price increases, and in amounts considerably greater than current production requirements, is likely to be followed by a substantial short run drop in purchases. This reduction in buying will be aggravated if purchasers find their actual requirements smaller than expected, and thus have unnecessarily large stocks of steel on hand. A considerable part of the decline in orders for steel that took place in the six or eight months following March, 1937, can be accounted for by the great volume of forward buying between October, 1936, and March, 1937, and the failure of actual requirements to come up to expectations after March.

In summary, while price changes and anticipated price changes affect the timing of steel purchases, the large fluctuations in the total volume of steel production during the 1936–1939 period cannot be attributed to changes in the levels of steel prices. On the contrary, the evidence compels the conclusion that the influence of the level of steel prices on the total consumption of steel was relatively unimportant.

III. Nature of the Demand for Steel

Considerations of central importance in any investigation of the demand for steel are:

(1) Steel itself is a durable commodity; that is, it may, with some exceptions, be kept in stock for more or less long periods without serious physical depreciation. Thus purchasers of steel may currently buy more steel than they need for current consumption, building up a stock of steel for future consumption. Conversely, the building up of such a stock in the past enables

a steel purchaser (user of steel) currently to *buy* less steel than he *consumes*, the balance of such consumption coming from depletion of his steel stock.

The size of these inventories will depend for the most part on the buyer's present and expected production requirements of steel, on his anticipations regarding near future prices of steel, and on his expectations regarding the length of time it will take him to get delivery on near future orders of steel. If the steel buyer expects that prices of steel shortly will be higher, or that near capacity operations of steel producers may delay delivery on his orders at a time when he expects his requirements will be high, he may currently buy more than he needs for present consumption, stocking steel as protection against future higher prices or delivery delay. On the other hand, if his steel requirements turn out to be smaller than expected, he may find himself with unnecessarily large inventories of steel on hand, and thus may consume from stock and curtail his buying. This will be expecially true if the steel buyer expects lower steel prices in the near future.

However, such changes in inventories for the most part exert only a short run effect on steel buying, for, as already pointed out:

(a) Investment in inventories ties up capital, and thus is costly; and

(b) Drastic changes in inventories are risky; the buyer must be relatively sure of the near future course of prices, and of his own production requirements before he can afford to build up or deplete his stock much out of line with his reasonably expected volume of consumption of steel. Such anticipations are the more uncertain the further into the future they extend.

This is not to say that changes in the size of steel inventories in the hands of consumers are unimportant *in the short run*. Such changes are probably of paramount importance in explaining the heavy buying of steel in the fall and winter of 1936–37, and the drastic decline that followed.

(2) Steel is largely used in the production of *durable* producers' and consumers' goods.*(1)** As shown elsewhere, however, the demand for durable goods is particularly subject to severe cyclical fluctuations. It is to be expected that the demand for steel should likewise be severely affected by general business cycles, since the demand for steel is ultimately derived from the demand for the services rendered by durable goods.

(3) The demand for steel is inelastic. This means that a given percentage change in the price of steel gives rise to a smaller percentage change in the quantity of steel demanded. A reduction in the price of steel (if unassociated with other factors such as improving business conditions) therefore tends to reduce the dollar volume of steel sales. This inelasticity of the demand for steel follows from three factors:

(a) The low elasticity of demand for most of the finished products which are made from steel;

(b) The low degree of substitutability of steel for other materials and of other materials for steel. This low substitutability materially lessens the responsiveness of the demand for steel to the changes in price; and

(c) The relatively small proportion of the value of the finished product which is represented by the cost of steel. A large percentage change in the price of steel can lead to only a small percentage change in the price of the finished product even if the entire steel price reduction is passed on to the final consumer. Since finished products made from steel have, in general, a low elasticity of demand, changes in steel prices, can have only a small effect on the output of finished products, and, therefore, on steel sales.

These considerations taken together lead to the conclusion that the large changes in the demand for steel, which were associated with the changes in the prices of steel during the period 1936–1938, were the result of (1) changes in business conditions, (2) anticipation of future price changes, and (3) anticipation, at times, of future delivery delays, rather than of actual changes in the price of steel.

This conclusion is verified by the following consideration of the actual course of events between June, 1936, and October, 1939.

IV. Short Run Variations in the Demand for Steel: June 1936 to October 1939

A. THE ECONOMIC BACKGROUND, 1930 TO 1935

To analyze the behavior of the demand for steel in the period June, 1936 to October, 1939, an understanding of the economic developments in the depression

years 1930 to 1935 is necessary. These prior developments can be most fruitfully appraised in terms of their later effects on the demand for steel if they are broken down into three classes: (1) developments affecting the potential demand for producers' durable goods, (2) developments affecting the potential demand for consumers' durable goods, and (3) developments in Government economic policy.

(1) *Developments Affecting the Potential Demand for Producers' Durable Goods*

(i) The population of the United States at the end of the year 1935 was almost five percent greater than at the end of 1929, and was increasing at the rate of about seven-tenths percent per year. (*2*)

(ii) In the face of this substantially larger potential market for goods, the productive capacity of American industry had actually declined slightly. The accumulated excess of consumption of business plant and equipment over production of these goods in the six years 1930 to 1935 amounted to more than three and a half billions of 1929 dollars. In the six years 1924 to 1929 there had been a net excess of production over consumption of these goods totaling almost twenty-one billions of 1929 dollars. (*3*)

(iii) Business expenditures (in 1929 dollars) on plant and equipment, which at the bottom of the depression had fallen to about one-third of their 1929 level, had in 1935 regained only about one-third of the depression loss and then stood at slightly over one-half of the 1929 level.[3] Practically all of the recovery that had been made in capital expenditures, moreover, had been gained in *equipment* expenditures. By the end of 1935 business expenditures on equipment had regained almost half of their depression loss, and were approximately two-thirds of the 1929 figures. (*3*) Yet business expenditures on plant, which in 1933 had fallen to one-quarter of the 1929 amount, had in 1935 regained only one-sixth of the loss, and stood at less than forty percent of the 1929 level. (*3*)

It is thus clear that up to the beginning of 1936 practically no recovery at all had been made in *long-term* investment commitments in the business plant of the country, and that recovery even in business equipment expenditures had been small. Moreover, what recovery there had been in equipment expenditures consisted largely of *replacement outlays* made on a short-term basis as required by current demands on productive capacity.

(iv) Behind this picture of small recovery in capital goods production and in long term investments, lies another, the picture of a similarly small recovery in business profits.

In 1932 corporate net earnings had dropped from a 1929 peak of over $8 billion to a net *deficit* of over $5 billion; by 1935 they had recovered only slightly more than one-half of the decline, and were only about *one-fifth* of the 1929 level. (*4*) Thus, there had been little incentive for business men to make investment commitments in the years 1930 to 1935. (*5*) But more important in interpreting later developments, the fact that the current level of profits at the end of 1935 was so low, and the previous six years on balance so heavily on the deficit side, (*6*) made the outlook for *long term investment* in heavy capital goods an exceedingly bleak one.

(v) Contrasted with the small recovery in profits and business capital outlays was a somewhat more substantial recovery in consumers' outlay and consumers' income. Consumers' real expenditures in 1935 were only about thirteen percent below the 1929 level, and had regained one-half of the depression loss. (*7*) Consumers' real income in 1935 was similarly only about thirteen percent below its 1929 level. (*7*) By the end of 1935, therefore, 1929 levels of activity in consumers' goods production were not far distant.

It is clear that the recovery which had taken place in the years 1933 to 1935 was largely a consumption recovery, with capital expenditures consisting mostly of the replacement outlays required by increasing production of consumers' goods. A sustaining base of recovery in *long term* investment commitments was absent.

(2) *Developments Affecting the Potential Demand for Consumers' Durable Goods.*—Beside the five percent increase in population which had occurred in the years 1930 to 1935, three important developments in the three major categories of consumers' durable goods, automobiles, housing, and housefurnishings had taken place:

(i) *Automobiles* (*8*).—With the decline in income after 1929, consumers drastically curtailed their purchases of new automobiles. In the low year, 1932, passenger car sales were only one-quarter of the 1929 level. With consumer income increasing the years 1933 to 1935, automobile sales recovered about one-half of the 1929 to 1932 decline; the total for 1935 was almost two-thirds of that for 1929. (*9*)

The total consumer stock of passenger cars, which had increased seven million in the six years 1924 to 1929, had grown less than half a million in the six depression years 1930 to 1935. (*10*) Moreover, the age of the stock had increased greatly. At the end of 1935 almost half of the cars were more than six years old, whereas, in 1929 only about one-seventh were more than six years old. (*10*) Thus, at the beginning of 1936 there loomed a very large potential "modernization" demand for automobiles. With consumer income at that time already not far from pre-depression levels, only small increases would be required to bring forth that demand.

(ii) *Household Furnishings*.—Expenditures (in 1929 dollars) for household furnishings fell less in the depression, and had recovered more than for automobiles. At the bottom in 1933 they had fallen to about 55 percent of their 1929 level; in 1934 and 1935 more than half of the loss had been recovered. (*11*) In the case of household furnishing there existed not only a potential *replacement* demand, but also a large potential demand for "new invention" goods which had only begun to come on the market before the depression—such goods as electric refrigerators and other new electric appliances.

(iii) *Residential Construction*.—Developments in housing were in marked contrast to those of other consumers' durable goods. Total expenditures (in 1929 dollars) on residential construction at their low point in 1933 were only about one-sixth of the 1929 figure, and approximately one-tenth of the predepression peak in 1925 when the total was over $5 billion. Practically no recovery was made in 1934, and in 1935 the total was only about 40 per cent of that in 1929 and only one-quarter of the depression drop had been regained by that time. (*12*)

The result of this drastic decline in the level of housing expenditures was the accumulation of a potentially large replacement and modernization demand. In the six years 1930 to 1935 the excess of consumption of residential housing over construction had accumulated to a total of eight and a half billions of 1929 dollars, about seven times the amount spent in 1935, and almost three times the 1929 total. (*12*) Add to this decline of the stock of housing, its greatly increased average age, the five percent increase of population, and the great technical developments in housing construction and it is clearly apparent that at the beginning of 1936 there was an extremely large potential demand for housing.

Although relatively unimporatnt in the midst of the depression, the relation between rents and costs became increasingly significant in the upswing, particularly in early 1936. (*13*) From 1929 to 1933 the decline in construction costs in most localities was not as great as the decline in rentals. However, in 1934 and 1935 a substantial recovery was made in rents while costs rose considerably less. Though the relation of rents to costs at the beginning of 1936 was more favorable, the situation was still precarious; a rather small rise in costs relative to rents would be sufficient to stop recovery.

(*3*) *Developments in the Field of Government Economic Policy*.—In 1933 the Federal Government inaugurated an unparalleled program of participation in the economic activity of the country in the hope of hastening recovery The most important of the developments were:

(i) A heavy deficit spending program in which the *net* contribution of the Federal Government to disposable cash income increased from an average of $160 million a month in the last ten months of 1933 to $310 million a month in 1935. (*14*)

This deficit spending was a very important factor in the 1933 to 1935 recovery of consumers' income and outlay, but uncertainty as to the future course of spending, and the increase of the Federal debt, (*15*) contributed to the absence of recovery in new long term investments.

(ii) Marked changes were made in Government monetary policy. The Thomas inflation amendments to the Agricultural Adjustment Act in 1933, the devaluation of the dollar and the Silver Purchase Act of

1934, the Banking Act of 1935, along with a rapid and uncontrolled flow of gold into the United States, and rise of the Federal debt made business men extremely apprehensive of rapid price inflation.

(iii) Government support of increasing wage rates, and the stimulation of the growth of labor organizations by new Federal statutes brought to business fears of rising wage costs and impending production stoppages.

(iv) The N. R. A., the A. A. A., and other price-production experiments made business men highly uncertain as to the future course of Government industrial policy.

In summary, this was the background situation at the beginning of 1936:

(1) Consumers' income and outlay and industrial activity—except in the heavy capital goods industries—were already approaching pre-depression levels.

(2) With more and more industries nearing capacity operations, the level of activity at which business expenditures for replacement of equipment could no longer be deferred was not far distant. Greater activity in the capital equipment industries would in turn increase consumers' income and thus the demand for equipment.

(3) Similarly, a continued rise of consumers' income was almost certain shortly to bring forth the "modernization" demand for consumers' durable goods (except possibly housing) whose purchase had been deferred in the previous six years of depression.

(4) The belief was becoming wide-spread among business men that the policies of the Federal Government would lead to price inflation.

(5) Investment—in housing and business plant—based on a long term outlook had made little recovery.

The situation was dominated by the short run outlook, and was for that reason vulnerable. All the elements of a short run boom were there, but the requirement for a sustained recovery—recovery in outlays made on the basis of the long term outlook—was lacking. Reasonable certainty as to the future was absent. There was thus a real danger that a boom might develop, reach runaway proportions, and collapse without any cushion of long term industrial activity to fall back upon.

B. THE BOOM: JULY 1936 TO MARCH 1937

Although business activity had declined somewhat in the winter of 1935–1936, sentiment among steel consumers by mid-spring was predominantly optimistic in regard to immediate prospects. These feelings were undoubtedly strengthened by the rapid and unbroken rise which advanced stock prices more than two-thirds above their March, 1935 level (*16*) and the fact that the enactment of the Veterans' Bonus in the winter promised a high level of activity in the last six months of 1936. By May, most of the business activity indexes were moving upward, some experiencing rather substantial contra-seasonal rises. But the situation as yet had little of the characteristics of a boom, although there was beginning to be considerable discussion of the possibility of inflation.

(1) *Initiation of the Boom—July to December 1936.*—A combination of events beginning in the three months May, June, and July, 1936, however, started an upward movement of prices and industrial production which reached the status of a boom by the end of the year:

(i) Payment of the Veterans' Bonus in June brought about a big increase in consumers' income. (*17*) The result of the payment was to be felt in the next six or eight months through its effect on sales of consumers' goods.

(ii) The agricultural drought early in the 1936 crop season, and world-wide re-armament accelerated by the Spanish Civil War led to a rapid rise in the prices of basic agricultural products and industrial raw materials. (*18*)

(iii) Of great importance in strengthening the feeling of price inflation in the summer of 1936 was the prospect of higher wage rates arising out of threats to organize such basic industries as steel and automobiles.

The addition of these developments to a situation already containing the basic elements of a boom was all that was necessary to make the boom—and price inflation—a reality.

The progress of the boom as it affected the steel industry in the last six months of 1936 is indicated in Table 1. Instead of the usual summer decline in orders, shipments, and production, actual increases occurred, so that the third quarter was somewhat better than the second. By the beginning of the last quarter activity had definitely taken on boom proportions.

TABLE 1.—*Composite Steel Price, U. S. Steel Corporation Subsidiaries Bookings and Shipments, and Total Ingot Production*

Date	*Iron Age* Composite Price of Finished Steel (cents per pound)[1]	U. S. Steel Corp. Domestic Bookings of Rolled and Finished Steel (000's of gross and net tons)[2]	U. S. Steel Corp. Domestic Shipments of Rolled and Finished Steel (000's of gross and net tons)[2]	Steel Ingot Production in the United States: Total (000's of gross tons)[3]	Steel Ingot Production in the United States: Percent of capacity[3]	Steel Ingot Production in the United States: Federal Reserve Board Index Adjusted for Seasonal Variation (1923-25 = 100)[4]
	(1)	(2)	(3)	(4)	(5)	(6)
1929*	2.209¢	1,264.9	1,168.9	4,571	89.05	131
1930*	2.048	923.9	900.1	3,300	63.09	95
1931*	1.957	554.9	596.9	2,119	38.13	61
1932*	1.901	274.1	311.8	1,122	19.75	32
1933*	1.879	433.8	450.5	1,908	33.53	54
1934*	2.033	520.1	449.3	2,162	37.38	62
1935*	2.058	619.0	572.7	2,828	48.54	81
1936						
Jan.	2.062	771.0	685.8	3,086	52.39	88
Feb.	2.040	604.9	619.2	3,002	54.53	85
Mar.	2.021	926.3	736.0	3,384	57.40	85
Apr.	2.028	877.1	931.9	3,991	69.99	102
May	2.028	818.4	883.6	4,097	69.58	107
June	2.033	1,055.8	876.7	4,035	70.75	115
July	2.091	1,092.4	886.3	3,975	67.61	121
Aug.	2.091	838.9	874.4	4,247	72.11	123
Sept.	2.096	953.8	898.1	4,214	74.05	121
Oct.	2.116	1,144.5	952.7	4,601	78.15	130
Nov.	2.116	909.0	853.1	4,389	76.94	141
Dec.	2.199	2,033.3	985.9	4,491	76.42	147
Monthly Average	2.077	999.6	848.5	3,959	68.36	113
1937						
Jan.	2.249	1,302.8	1,143.2	4,796	81.32	142
Feb.	2.249	1,270.1	1,040.8	4,498	84.27	131
Mar.	2.459	1,839.2	1,332.9	5,303	89.94	128
Apr.	2.512	1,167.0	1,224.8	5,155	90.25	132
May	2.512	838.7	1,211.8	5,237	88.79	136
June	2.512	866.9	1,174.0	4,254	74.48	121
July	2.512	840.6	1,060.5	4,631	78.48	141
Aug.	2.512	793.7	971.7	4,958	83.83	144
Sept.	2.512	693.0	946.9	4,362	76.30	125
Oct.	2.512	511.0	665.3	3,449	58.31	101
Nov.	2.512	471.1	470.1	2,189	38.23	68
Dec.	2.512	477.9	406.6	1,496	25.37	49
Monthly Average	2.464	922.7	965.7	4,193	72.38	118
1938						
Jan.	2.512	426.8	484.1	1,733	29.15	52
Feb.	2.512	376.9	380.4	1,704	31.74	51
Mar.	2.512	503.8	476.4	2,012	33.85	49
Apr.	2.512	541.8	450.5	1,925	33.44	50
May	2.506	338.3	399.6	1,807	30.39	48
June	2.459	428.6	443.6	1,638	28.46	47
July	2.300	485.0	410.6	1,982	33.42	64
Aug.	2.300	518.1	525.8	2,547	42.85	72
Sept.	2.293	653.5	525.7	2,658	46.28	77
Oct.	2.255	729.1	635.1	3,118	52.45	92
Nov.	2.286	778.0	626.7	3,572	62.05	112
Dec.	2.286	655.0	670.3	3,143	53.00	104
Monthly Average	2.394	536.2	502.1	2,320	39.79	68

* Average of monthly figures.
[1] See: *The Iron Age*, January 5, 1939, p. 199.
[2] Source: U. S. Steel Corporation.
[3] See: *The Iron Age*, January 5, 1939, p. 191.
[4] See: *Federal Reserve Bulletin*, June 1937, July 1937, p. 675, July 1938, p. 609, July 1939, p. 594, October, 1939, p. 915.

TABLE 1.—*Composite Steel Price, U. S. Steel Corporation Subsidiaries Bookings and Shipments, and Total Ingot Production*—Continued

Date	*Iron Age* Composite Price of Finished Steel (cents per pound)	U. S. Steel Corp. Domestic Bookings of Rolled and Finished Steel (000's of gross and net tons)	U. S. Steel Corp. Domestic Shipments of Rolled and Finished Steel (000's of gross and net tons)	Steel Ingot Production in the United States		
				Total (000's of gross tons)	Percent of capacity	Federal Reserve Board Index Adjusted for Seasonal Variation (1923-25 =100)
	(1)	(2)	(3)	(4)	(5)	(6)
1939 [5]						
Jan.	2.286	829.3	734.6	3,174	52.69	95
Feb.	2.286	622.9	602.7	2,989	54.10	89
Mar.	2.286	662.4	678.1	3,405	56.14	84
Apr.	2.286	603.6	715.0	2,974	50.99	80
May	2.236	623.9	639.0	2,923	48.24	75
June	2.236	670.9	662.6	3,125	53.44	90
July	2.236	655.3	618.0	3,163	52.40	102
Aug.	2.236	719.3		3,764	62.22	107
Sept.	2.236					

[5] The 1939 figures for *The Iron Age* Composite Price of Finished Steel are for the middle week af the respective months, and are from current issues of *The Iron Age*. The 1939 figures for columns (4) and (5) are from current Issues of *The Iron Age*. The 1939 figures for total steel ingot production (column 4) do not include steel for castings. The 1939 bookings figures are not strictly comparable to those of previous years since they do not include "requirement contracts"– that is, "price protection" contracts without actual specifications.

The developments of the last six months of 1936 can best be analyzed in terms of their effects on the demand for steel if they are studied in three groups: (a) Developments affecting the demand for steel by the consumers' goods industries; (b) Developments affecting the demand for steel by the producers' goods industries; and (c) Behavior of the price of steel.

(a) *Developments Affecting the Demand for Steel by the Consumers' Goods Industries*

(1) *Automobiles.*—By the time production of the new 1937 models was in full swing in October, 1936, automobile makers were already predicting a 5,000,000 car year, *i.e.*, one about as large as that in 1929. (*19*) Automobile producers justified their anticipation on the basis of (1) the unusually high level of sales in the spring, (*20*) (2) the generally rapid rise of consumers' income and industrial activity and the widespread optimism that business activity was going to continue upward, (3) the boost to sales expected as a result of the Veterans' Bonus, and (4) a recognition that consumers had a large depression "backlog of deferred purchases" to make up.

Nor were these feelings unjustified by the events of the last quarter of 1936. In October, November, and December, orders for the 1937 models poured in to producers at a 1929 pace. (*21*) Seasonally adjusted retail sales of automobiles in November and December were up to the 1929 peak level and about forty percent greater than the corresponding months in 1935. (*20*)

By the end of December, automobile producers had already placed orders for considerably more than half of the steel requirements on their expected production of 1937 models. (*22*) Inasmuch as the automotive industry was the biggest steel consumer, these orders were undoubtedly a major factor accounting for the high level of steel bookings in the last four months of 1936.

(2) *Household Goods.*—The situation in the household goods industry was not substantially different from that in automobiles. Though few monthly figures on orders, sales, or production of household goods are available, quarterly data for sales of electric stoves and electric household refrigerators, and shipments of vacuum cleaners indicate that sales of household goods in the last quarter of 1936 must have been 25% to 50% greater than in the corresponding quarter of 1935. (*23*)

Although the household goods industry is not one of the major consumers of steel, some rather substantial tonnages were undoubtedly placed in the last half of 1936, especially for lighter types of steel.

(3) *Residential Construction.*—Activity in residential construction was in marked contrast to that in automobiles and household goods. In March, 1936, the value of residential construction contract awards began a rapid upward climb. By mid-summer it appeared that the long-delayed recovery in housing was at last under way; August contract awards (adjusted for seasonal variation) were over 80 per cent greater than for February. (*24*)

However, the recovery was short-lived. Contract awards (seasonally adjusted) reached a peak as early as September, and were about seven per cent lower in the last quarter than in the third. An important factor in cutting short recovery was the rise in building costs that took place in the last half of 1936. (*13*) Though residential construction undoubtedly contributed to the high level of steel activity in the last half of 1936, it was apparent before the end of the year that—barring an unusual rise in rents, or a miracle—no further stimulus could be expected from that quarter. Already an important deflationary element had entered the picture.

(b) *Developments Affecting the Demand for Steel by the Producers' Goods Industries*

(1) *Railroads.*—In April, 1936, freight car loadings began an upward rise, which increased in rapidity in the following summer and autumn. By December, 1936, they had advanced to a level about twenty-five per cent above the March figure and that for the previous December. Although the level of freight car loadings in the last half of 1936 was about twenty-five per cent under the 1929 amount, the railroads' stock of serviceable freight cars had been so depleted (by failure to replace) in the depression years that the freight car surplus in the last half of 1936 was actually more than forty percent under the 1929 average surplus. (*25*)

Revenue passenger-miles in the last half of 1936 were about twenty-five per cent above the first half of 1936. (*25*)

As a result of increased freight and passenger traffic, net railway operating income advanced rapidly. The average for the last quarter of 1936 was over 30 per cent greater than for the fourth quarter of 1935. The railroads' net income for the same periods rose from $63 million to $126 million. (*25*)

With traffic nearing capacity levels, and with a greatly improved profit outlook and current income situation, the railroads came into the market with a tremendous upward spurt of orders in November and December, 1936. (*27*) New orders of freight cars in December were greater than the total for the year 1935. The number of new locomotives ordered in November and December was greater than the combined total for the three years 1932 to 1934. Orders for passenger cars and steel rails similarly showed great increases. Undoubtedly the greatly increased demand of the railroads for rails and rolling stock was an important factor in the great rise in bookings of heavy steel in the last quarter of 1936, and especially in December.

(2) *Machinery and Equipment.*—What was happening in the railroad industry was happening more or less similarly in industry in general. In April, 1936, industrial production began to move rapidly upward; by December it had advanced more than twenty-five per cent over March (on a seasonally adjusted basis), and had actually reached the average level for 1929. (*6*) In view of the decline of the stock of machinery and equipment that had taken place since 1929, wide areas of industry were undoubtedly operating at or near capacity in the last half of 1936. Thus, if demands on productive capacity were to be met, further postponement of outlays for replacement of industrial equipment was no longer possible.

An added incentive to make equipment outlays came from the fact that the profit outlook was substantially improved. Profits of industrial corporations for the fourth quarter of 1936 were more than forty percent above the corresponding period of 1935, although still not much more than half the 1929 level. (*26*)

By mid-summer new orders of industrial equipment were increasing rapidly, and by autumn activity in the machinery and equipment industry was definitely in the boom stage. The year 1936 ended with a tremendous spurt of new orders in December.(*27*)

Part of the increase of new orders was caused by rising equipment prices in the last half of 1936, and the expectation that prices were going to rise still further.(*28*) A substantial volume of orders for equipment which was not required by current demands on capacity and which otherwise might not have been purchased was placed as protection against expected price advances. This was undoubtedly true in December when widespread expectations of price advances early in the first quarter of 1937 caused many buyers to protect themselves by ordering in advance.(*28*)

(3) *Business Construction.*—Activity in the business construction industry began to rise in the spring of 1936, and continued to advance throughout the remainder of the year, but at a slower pace in the last quarter.(*29*) Although the total value of construction contracts awarded for commercial and factory buildings and public utilities in the last half of 1936 was more than sixty percent greater than for the same period in 1935, it was only slightly more than one-sixth of the total for the full year 1929; recovery was undoubtedly still being impeded by the low level of profits. However, the increase in 1936 contributed importantly to the advance of activity in heavy steel production.

(4) *Public Construction.*—Developments in public construction were markedly different from those in private building. The value of construction contracts awarded for public buildings and public works and the value of highway and grade crossing projects approved for construction, which had risen very rapidly in the years 1934 and 1935, continued to increase throughout most of the first half of 1936.(*29*) The peak, however, was reached early in the summer, and the last half of the year was largely one of decline. The reasons for the decline were:

(i) With private industrial activity increasing, there was less pressure to provide employment on public projects; and

(ii) Fears that continued public spending would lead to runaway price inflations and demands for a balanced Federal budget prompted a reduction of Federal construction outlays.

Though public construction expenditures even in the last half of 1936 were at a higher level than for 1935, the outlook for 1937 was one of a continuing reduction. Thus another important deflationary element was added to the prospects for 1937.

(c) *The Behavior of the Price of Steel.*—From the discussion of the previous pages, it is apparent that the great upward shift of the demand for producers' and consumers' goods in the last half of 1936 undoubtedly would have caused a large increase in the demand for steel irrespective of what had happened to its price. As we shall see, however, the behavior of the price of steel actually increased this demand.

During the first half of 1936 steel prices were for the most part unchanged. In the last part of May, however, leading steel producers announced small price advances on many steel products effective beginning July 1, for third quarter shipments. The increases raised the average level of steel prices about three or four per cent.(*30*) The effect of the price advances was to strengthen expectations of further price increases.(*31*) There followed a substantial amount of orders in June as protection against price increases.(*32*) There is no evidence that the price increases had any important effect on steel purchases in the third quarter; July bookings were greater than the total for June, and the total for the third quarter greater than that for the second. (*33*)

Prices for a few steel items were raised in September and October, 1936, but the effects of the advances were slight, except to further the now widespread anticipations of substantial increases over a wide range of steel products.(*34*) These expectations were bolstered by (1) rapidly rising prices elsewhere in the economy,(*35*) (2) the great increase in steel activity, (3) the rising cost of steel scrap,(*36*) and (4) expectations of an early rise in wage rates in the steel industry.(*37*)

On November 16, 1936, a wage rate increase of approximately ten per cent was granted to steel workers by the majority of steel producers.(*37*) The effect of this advance was materially to increase the cost of steel production.

Other increased costs had become effective in 1936, including the Social Security Tax, and, in the case of the manufacturing subsidiaries of United States Steel Corporation, vacations with pay to certain employees. Soon after the wage advance of November, 1936, price announcements for shipments during the first quarter of 1937 were made by the principal steel producers. The announced price increases covered practically the whole range of important steel products and raised the average level of steel prices about six per cent.*(38)* The immediate effect of the price advance was the placing in December of a very large amount of forward orders as protection against the announced January price advances.*(39)* December bookings of the subsidiaries of United States Steel Corporation were more than double those in November, more than twenty-five percent greater than the peak month in 1929, and were the largest monthly post-war bookings in the history of the Corporation.*(40)*

Although a great increase in bookings might have been expected in December because of a simultaneous large upward shift in the demand for products made from steel,*(41)* the magnitude of the increase indicates clearly the importance of speculative forward buying in that month.

An additional element that entered the picture in December, 1936, and stimulated buying, was that deliveries—especially of steel sheets—were being delayed by pressure on capacity. By mid-December deliveries of steel sheets, for example, could not be promised within less than three or four months. *(42)* With producers of products made from steel expecting large steel production requirements in the first six or eight months of 1937, some forward tonnages were placed in December as protection against future delivery delay.

(2) *The Critical Period: January to March 1937.*—Domestic bookings of steel in January and February 1937 dropped approximately 35 per cent from the December level although they were still about 30 per cent above the level of the previous October and November.*(33)* The most important reasons for the decline were:

(i) Steel consumers had undoubtedly covered a large part of their first and second quarter requirements in 1937 by orders in the last quarter of 1936, and especially in December.*(43)*

(ii) Further steel price advances, although anticipated as the outcome of rising costs in the steel industry, were not expected much before the beginning of the second quarter of 1937.*(44)* Thus in January and February there was little price incentive for protective forward buying. This factor alone is sufficient to account for a large part of the drop from December, 1936, when advance buying had been very large.

(iii) New orders of products made from steel similarly had declined from a high forward buying level in December, 1936.*(45)*

(iv) Widespread strikes prevented substantial specifications of steel from the automobile industry.

Although bookings had declined, the large backlog of orders, placed in the last quarter of 1936, raised production and shipments of steel in January and February, 1937, above the corresponding December figures.*(33)*

In March, however, there was another upswing in orders of steel. Bookings were almost fifty per cent greater than for February, but were about 10 per cent under the peak figure for December, 1936.*(33)* Several factors were responsible for the increase in orders in March:

(i) On March 2, 1937, Carnegie-Illinois Steel Corporation signed a labor contract with the Steel Workers Organizing Committee which was followed by formal contracts signed a few days subsequently by this and other manufacturing subsidiaries of United States Steel Corporation. Under these contracts the basic common labor rate was increased about twenty percent and there was established an eight-hour working day and a forty-hour working week, with time and a half compensation for all overtime in excess of eight hours in any day, or in excess of forty hours in any week, such changes becoming effective March 16, 1937. Other steel producers granted similar wage advances. The signing of this first labor contract was immediately followed by the announcement by various subsidiaries of United States Steel Corporation in the first week of March, 1937 of price increases on most steel products. Similar price increases were announced by other steel producers. These price increases on the average raised second quarter prices

about ten percent above the level for the first quarter.(*46*) The announcement of Carnegie-Illinois Steel Corporation stated that the price increases were necessary to cover the increased cost of production due to labor advances. A considerable part of the new orders in March consisted of forward purchases placed as protection against these second quarter price advances.

(ii) At the same time the demand for products made from steel rose greatly in March. Sales of automobiles and house-furnishings were much larger than in January and February.(*47*) Rising industrial production and anticipations of price increases also occasioned a large upward spurt of new orders for machinery and equipment.(*48*)

(iii) Some large tonnages were also placed as protection against future delivery delay. In March, delivery for some of the light finished steels could not be promised within less than approximately six months. (*49*) Threatened production stoppages due to possible labor difficulties bolstered these fears of delivery delay.

In the meantime, however, several critical developments pointing to an almost certain early collapse of steel buying were materializing:

(i) After a rapid rise in 1936, a decline of over 1.5 percent in real income (adjusted for seasonal variation) occurred in January, 1937, and by March it was beginning to be apparent that consumers' real income was in the leveling off stage. (*50*)

In addition, the Federal Government was reducing its expenditures while at the same time considerably increasing its tax revenues; (*14*) the increase was due largely to heavy Social Security Tax collections beginning in January 1937. As a result, the net contribution of the Federal Government to consumers' disposable cash income dropped from an average of $370 million per month in the last six months of 1936 to about $110 million per month in the first four months of 1937. Such a reduction was large enough to have significant deflationary effects. Since Government policy in the winter and spring of 1937 was definitely toward a reduction of expenditures, the outlook was for even further decline.

The great upswing in sales of consumers' goods in 1936 and the first quarter of 1937 had been abnormal. A substantial part of the sales undoubtedly consisted of "modernization replacement" purchases which had been deferred in the previous depression years, and which were made under the stimulus of the Veterans' Bonus and rapidly rising income. With a considerable part of the deferred backlog of purchases already made up by the spring of 1937, sales of durable goods could not be expected to continue at the high pace of the previous nine months unless consumers' income should continue to increase very rapidly. If consumers' income should decline, the level of sales was almost certain to drop.

Figures for automobile sales tend to support the above conclusion. The peak of sales (on a seasonally adjusted basis) was reached as early as December 1936. (*20*) March, 1937, was about 5 per cent below December, 1936, and June, 1937, about 20 percent below March.

Taking all these facts into consideration, the outlook at the beginning of the spring of 1937 was very definitely toward a leveling off of, or a decline in, consumers' expenditures. The immediate prospects for the consumers' durable goods industries were thus definitely not bright.

(ii). A somewhat similar situation existed for the durable producers' goods industries. Business expenditures for equipment in the twelve months, March, 1936 to March, 1937, were about 50 per cent greater than the corresponding outlays for 1935, and were at a level about equal to that in 1929. (*51*) By the spring of 1937 it was probably true that a major part of the backlog of replacement outlays deferred in the depression years had been made up. Thus, unless industrial production continued to increase at a rapid rate so that substantial outlays for expansion were required, expenditures on machinery and equipment were almost certain to decline.

But by the end of March, 1937, it was becoming clear that industrial production was not going to continue its rapid advance. The Federal Reserve Board index of industrial production (adjusted for seasonal variation) reached a peak in December 1936 slightly above the 1929 average, declined almost six per cent in January, 1937, rose slightly in February and March and then levelled off and began to decline in the second quarter. (*6*) Manufacture of non-durable goods (seasonally adjusted) was definitely on the decline by the end of March, 1937. (*6*)

The situation was aggravated by the fact that profits, after rising rapidly in 1936, also began to level off early in 1937. Seasonally adjusted profits for the first quarter were about one-sixth under the peak in the fourth quarter of 1936. (*26*)

Additional disturbing elements in the first quarter of 1937 were the strikes in the automobile, glass, rubber, machinery, and maritime industries, and organizational activities in the iron and steel industry. The number of strikes in progress in the United States trebled between December and March, (*52*) and there was little indication that production stoppages were going to decline.

(iii) The outlook for the railroads was also becoming much less optimistic. Merchandise freight car loadings (seasonally adjusted) began to decline as early as December, 1936, and miscellaneous loadings followed in February, 1937. (*53*) With traffic dropping off, though slowly at first, and with heavy replacement expenditures already made in the last quarter of 1936 and the first quarter of 1937, the pressure to provide further replacement was relaxed. Railroad buying collapsed in the second quarter.

The collapse was hastened by the decline of the railroads' income. Net income for each of the first and second quarters was far under the figure for the last quarter of 1936. (*25*)

(iv) By April, 1937, there was a growing feeling that prices, which had risen rapidly in the previous nine months, were very shortly going to stabilize. (*54*) Factors important in dampening speculative anticipation of further price inflation were:

(a) The excess of Government expenditures over receipts was being rapidly reduced.

(b) On December 21, 1936, the Secretary of the Treasury announced the gold sterilization policy, whereby gold inflows were to be prevented from contributing to inflation.

(c) This was followed on January 30, 1937, by the Federal Reserve Board announcement of a 33⅓ per cent increase in member banks' reserve requirements.

(d) In January and February substantial increases in the yields of government bonds occurred, and in March stock prices began to fall. (*55*)

(e) Rumors of an upward revaluation of the dollar in terms of gold had become so strong in the first quarter of 1937, that President Roosevelt was prompted to make a statement on April 9th that no change in the United States' gold policy was contemplated.

(f) In March, prices of basic raw materials began to level off. (*18*)

With expectations of further price advances disappearing, a most important stimulus to forward buying was being removed. Unquestionably many orders both of steel and of products made from steel placed in the nine months July, 1936 to March, 1937 had been of the speculative price protection variety.

(v) The mere fact that advance buying both of steel and of products made from steel had been so heavy in the fourth quarter of 1936 and the first quarter of 1937 pointed to a much lower level of orders throughout the two or three following quarters. By the end of March buyers of steel had covered a large part of their steel requirements for the next six or eight months. Total domestic bookings of subsidiaries of United States Steel Corporation in the six months, October, 1936 to March, 1937, were almost three per cent above the six consecutive peak months of 1929, although their total shipments in 1937 were more than seventeen per cent under the 1929 total. (*56*) Total bookings in the six months referred to were equal to almost three-quarters of the entire shipments made by the subsidiaries of the Corporation in 1937.

With a large part of their steel requirements for 1937 covered by the end of March, and with mills unable to promise delivery of all orders in hand in less than six months, it was to be expected that steel consumers would be hesitant about tying up more working capital and risking unduly large inventories with further advance buying.

C. THE DECLINE BEGINS: APRIL TO SEPTEMBER 1937

The demand for steel began to decline rapidly in April, 1937. By September, bookings had dropped more than sixty per cent below the March level. (*56*) But production and shipments were maintained at a high level throughout the second

and third quarters largely on the basis of the large backlog of orders placed in the winter of 1936–1937. Domestic shipments of subsidiaries of United States Steel Corporation for the third quarter were about fifteen per cent under the peak shipments of the first quarter; steel ingot production in the United States declined less than five per cent in the same period.

The basic factors responsible for the decline in demand beginning in April have already been indicated. In summary they were:

(1) Steel consumers had already placed orders for a large part of their second and third quarter requirements through heavy advance buying during the previous six months. Thus, even though their requirements had continued at a high level in the second and third quarters, they would have been obliged to come into the market for but little additional tonnage.

(2) With consumers' real income and industrial production and profits leveling off and beginning to decline in the second and third quarters, the demand for consumers' and producers' durable goods rapidly fell off. Thus steel requirements, both current and expected, were declining.

(3) In the previous boom months numerous steel consumers had optimistically estimated that their steel requirements would continue to increase in the second and third quarters, and had placed orders on that basis. Thus, when the expected increase in the orders for their finished products failed to materialize and demand actually dropped off, they found themselves with unnecessarily large inventories of steel on hand. (*57*)

(4) The general disappearance of expectation of further price inflation, bolstered by the fact that after March there appeared to be a general stabilization of steel prices, removed the price incentive for speculative forward buying. (*58*)

As already pointed out, there is little reason to believe, and little evidence to support the contention, that the decline in the demand for steel which began in April 1937 was caused by the advances in the price of steel in March and previous months. The decline would almost certainly have come at about the time it did, even though no price increases at all had been made. The changes in the other factors determining the demand for steel were too great to be offset by any changes in steel prices.

D. RECESSION: OCTOBER, 1937 TO JUNE, 1938

By the end of September, 1937, the backlog of steel orders had been worked off. (*59*) Thus, when general industrial activity collapsed abruptly early in October, the demand for steel continued on its rapid downward pace; production and shipments of steel by December had dropped precipitously to about one-third of the September level in the case of production and 43% of the September level in the case of shipments. (*33*)

The decline in general economic activity was most rapid; in the last quarter:

(i) Consumers' income (on a seasonally adjusted basis) declined about three per cent; (*17*)

(ii) Production of durable goods dropped about one-half; production of non-durable goods, one-eighth; (*6*)

(iii) Industrial profits decreased about one-quarter; (*26*) and

(iv) Stock prices fell one-fourth. (*60*)

Thus, the factors which were responsible for the spring and summer decrease in demand for steel were greatly intensified, and new deflationary elements entered to further the decline. The mistaken optimism of the winter and spring of 1937 turned to deep pessimism; advance buying and reduction of the 1930–1935 backlog of deferred purchases of durable producers' and consumers' goods turned to postponement of buying. Producers of products made from steel, who in the previous boom months had anticipated continued rising sales, now found themselves with greatly excessive inventories of steel and steel products. (*61*) Before a recovery in the demand for steel could be expected, these inventories had to be reduced; in the meantime the decline in the demand for steel was doubly aggravated.

Bookings, shipments, and production of steel continued downward until the middle of June, 1938, except for slight increases in March and April. (*33*)

Meanwhile steel prices remained unchanged. (*33*) It has been contended that a reduction of steel prices in the summer and fall of 1937 when demand was falling off rapidly would have cushioned the decline. In view of the above analysis, however, this seems very doubtful. The downward shift of the demand for

products made from steel and the inelasticity of their demand to price changes were too great, and inventories of steel and steel products too excessive, to be appreciably offset by any changes in the price of steel. Moreover, a reduction in steel prices by leading producers might even have intensified the decline in steel buying by creating anticipations of further price decreases.

E. RECOVERY: JUNE TO DECEMBER 1938

The decline of industrial activity, abrupt in the last quarter of 1937, continued for the most part throughout the first half of 1938, but at a much slower pace, especially in the second quarter. Slight—and possibly seasonal—increases in bookings, shipments, and production of steel occurred in March and April. *(33)* May, 1938, was the low point of the recession as measured by bookings of steel.

In the meantime the average level of steel prices remained practically unchanged. *(33)* However, the period was marked by a growing hesitancy in regard to the future course of steel prices, an increasing number of "rumors" of price concessions, and the strengthening of expectations of price cuts. *(62)*

In the middle of February, a reduction of $4 a ton was made on cold-rolled sheets in order to bring them into a more satisfactory relationship with hot-rolled sheets. *(63)* No noticeable effect followed from the reduction except an intensified uncertainty as to the future level of prices. *(64)*

Although steel producers in the latter part of February announced the continuation of first quarter prices into the second quarter (with the exception of some minor revisions in extras, and the recognition of the $4 break in the price of cold-ro led auto sheets), price uncertainty continued to grow. *(65)* In the second quarter there were numerous rumors that price concessions were being made. *(66)* This uncertainty undoubtedly caused a larger volume of postponed and hand-to-mouth buy'ng than might otherwise have occurred.

In May, 1938, revisions in classifications of sheets and strip steel were announced for the balance of the second quarter and the third quarter. *(67)* The reclassifications involved adjustments in extras for these individual products and were accompanied by a reduction in the average price level of these products, brought about by lowering the base price $2 per ton. *(68)* The announcements, however, did not remove price uncertainty and rumors of price concessions. In the first part of June, the price of galvanized sheet broke $3 a ton, and further concessions on the prices of other steel products were rumored to have followed. *(68)*

In the meantime, several important developments pointing to recovery of steel demand were materializing.

(i) In the first place, the large inventories of steel and steel products carried over from 1937 were being reduced to a level where steel consumers would shortly have to enter the market in order to meet their current production requirements. *(69)* Undoubtedly an important reason for the low demand for steel in the first half of 1938 was the fact that steel requirements were being met from stocks in the hands of steel consumers.

(ii) In April, 1938, the Federal Government announced a recovery program consisting of:

(a) The desterilization of $1.4 billion of gold in the inactive fund;

(b) A 13¼ percent reduction of member bank reserve requirements by the Federal Reserve Board; and

(c) A "four billion dollar pump priming" program. Beginning in March, the excess of Government expenditures over receipts rose rapidly. The net contribution of the Federal Government to consumers' disposable cash income rose from $221 million in the first quarter to $536 million in the second, *(14)* and expectations were that the rapid rise would continue throughout the year. Moreover, the large public works program announced in April promised large outlays in public construction in the last six months of 1938.

(iii) In February, 1938, activity in residential construction began a rapid upward climb. *(24)* Residential construction contract awards (seasonally adjusted) in June were about 10 per cent below the peak figure of the 1936–37 recovery. By the end of March, public works construction contract awards, and the value of highway and grade crossing projects approved for construction, were also rising rapidly. *(29)* The outlook for heavy construction steels was even better than it had been in the 1936–37 boom.

(iv) Manufacturing production in the first and second quarters of 1938 leveled off after the rapid decline in the fourth quarter of 1937, and slight seasonal increases occurred in February, March, and April. *(6)* On a season-

ally adjusted basis, manufacturing production in May was only about three per cent under the January figure. Production of non-durable goods (seasonally adjusted) began to rise in May; some of its component items—such as textiles and leather products—started to advance even earlier. With industrial production thus leveling off, and with manufacturing inventories substantially reduced from the excessive height at the end of 1937, the outlook for the last half of 1938 was an optimistic one.

(v) Profits of corporations in the second quarter of 1938 had risen above the figure for the first quarter, so that the profit outlook was improving. *(26)*

In the midst of rumored concessions in prices and uncertainty as to future prices, Carnegie-Illinois Steel Corporation announced, on June 24, 1938, price reductions of $3 to $4 a ton on nearly all steel products, and eliminated the basing point differentials at Chicago and Birmingham. *(70)* Other companies announced similar price reductions and named new basing points in the major production centers. On the average, announced steel prices were reduced eight to ten per cent.

Undoubtedly, price concessions and uncertainty as to future prices had restrictive effects on buying in May and early June. The price announcements in the latter part of June removed this uncertainty and served to bring out orders which buyers had been holding pending the price announcements. This accounts, to some extent, for the fact that bookings in May were about 35 per cent below the average of March and April..

The price reductions came at the same time as the expected rise in industrial activity began to materialize. Between June and December 1938:

(i) Consumers' real income (seasonally adjusted) rose over 5 per cent; *(17)*

(ii) Production of durable goods (seasonally adjusted) advanced over 80 per cent and regained 60 per cent of the recession loss; *(6)*

(iii) Production of non-durable goods (seasonally adjusted) rose 20 per cent, recovering two-thirds of the recession decline. December was about 25 per cent above the low point in April (on a seasonally adjusted basis); *(6)*

(iv) The total value of construction contracts awarded (seasonally adjusted) almost doubled. *(71)* The December figure was approximately 50 per cent above the 1936–37 peak and within 16 per cent of the 1929 average; and

(v) Profits of corporations more than doubled, recovering about one-half of the recession drop. *(26)*

With the resulting rapid upward shift in the demand for products made from steel, the demand for steel rapidly recovered. *(33)* Domestic bookings of subsidiaries of United States Steel Corporation in the fourth quarter were two-thirds above the recession low in the second quarter, but less than half the 1936–37 peak figure in the first quarter of 1937. Steel ingot production in the United States rose 80 per cent from the second quarter to the fourth.

The fact that price reduction occurred at about the same time as steel orders and general business activity began to improve has led some persons to believe that the price reductions were primarily responsible for the recovery in steel demand. Some have even contended that the steel price reductions were important factors in the general rise of business activity in 1938. These views, however, are not supported by the evidence. The basic factors responsible for the rise in steel demand had begun to improve weeks and months in advance of the price reductions. Even if steel producers had not cut prices in June, 1938, steel buying unquestionably would have followed about the same course as it actually did.

Steel prices held strong throughout the third quarter of 1938 except for a break of $4 a ton on automobile sheets on July 29. *(72)* Although the price concessions were temporary, substantial tonnages were placed by the automobile companies for their 1939 models.

In September, 1938 prices were reaffirmed for the fourth quarter but early in October, when automobile producers came into the market with inquiries for large tonnages, sheet and strip prices broke $4 a ton, followed by further concessions of $2 to $4. Similar concessions were extended to other flat rolled products. Although price concessions were withdrawn after a short time, all regular steel consumers were given an opportunity to place orders at the low prices. *(73)*

Inasmuch as most buyers realized that the price reductions were temporary, there occurred a large increase in bookings in October and November, 1938. *(74)* The effect of the temporary bargain market, however, was probably not to increase

the total buying of steel in the last quarter and the first few months of 1939, but only to bunch purchases at the time of the price break. To the extent that buyers took advantage of the price concessions, they reduced the volume of buying in the following three or four months.

F. RECENT DEVELOPMENTS: JANUARY TO OCTOBER 1939

By November, 1938, business activity began to level off, and in the first two quarters of 1939 industrial production and industrial profits declined slowly but substantially while consumers' income remained virtually constant. (*75*) The low point was reached in April and May, 1939, at a level about the same as that of September, 1938. (*75*) Two important factors contributing to the decline were:

(1) The nation-wide coal strike in April and May; and

(2) The great uncertainty regarding the foreign situation, especially after early March.

With the coal strike settled, and the foreign situation temporarily receding into the background, business began to recover in May, and by the end of August had reached the levels of November and December, 1938. (*75*) When war broke out in Europe at the beginning of September, 1939, the advance was greatly accelerated. Currently, activity in many lines of business is near the levels of the summer of 1937. Undoubtedly a substantial part of the recovery since September 1st, 1939 has been of the speculative inventory-building-up variety, induced by fears of rising prices and delivery delay.

The course of general business activity was closely paralleled by the demand for steel. Seasonally adjusted bookings, shipments, and production declined until May, 1939. (*76*) The decline was aggravated by the carry-over of steel purchased during the price-concession period in the previous October. (*77*) Prices of steel meanwhile continued steady, but with numerous signs of weakness by April, which contributed to the hand-to-mouth buying of steel at that time. (*78*)

In the first part of May when automobile producers entered the market for steel for their 1940 models, a sharp break in steel prices occurred, especially in sheet and strip products. (*79*) All buyers were given an opportunity to place orders, and a large volume of purchases were made, at the low prices before the concessions were withdrawn.

It seems likely that the price concessions of May, 1939, like those of October, 1938, served only to bunch steel orders at that time, without significantly affecting the tonnage sales for 1939. Certainly the lowered price of steel has not had any appreciable effect in lowering automobile prices. For steel producers, however, such temporary price cuts, which do not significantly increase their total volume of sales over a six or eight months period, can only mean decreased revenues.

With industrial production, consumers' income, and industrial profits rising after May, 1939, the demand for steel recovered, and steel prices strengthened somewhat. (*80*) Then, when war broke out on the first of September, bookings bounded upward, and currently activity in the steel industry is almost at capacity levels. Unquestionably a large part of the increase in the demand for steel since the first of September has been caused by fear of rising steel prices and delivery delay.

G. CONCLUSION

A careful examination of the record shows that changes in the demand for steel during the 1936–1939 period were largely determined by the following factors:

1. The current and anticipated levels of business activity, income and profits;
2. The expectations with respect to steel prices in the immediate future as compared with current steel prices;
3. The volume of steel inventory accumulated in the immediate past; and
4. The length of time required to fill new orders for steel.

Although price changes and anticipated price changes affect the timing of steel purchases, the large fluctuations in the total volume of steel production during the 1936–1939 period cannot be attributed to changes in the levels of steel prices. On the contrary, the evidence compels the conclusion that the influence of the level of steel prices on the total consumption of steel was relatively unimportant.

APPENDIX

(1) Tin plate, the most important exception, is mainly used in the production of perishable containers, i. e., cans which are used a single time.

(2) TABLE 2.—*Midyear population estimates for continental United States*

Year	Population estimate	Percentage increase	Year	Population estimate	Percentage increase
1929	121,526,000		1934	126,626,000	0.68%
1930	123,091,000	1.29%	1935	127,521,000	0.71
1931	124,113,000	0.83	1936	128,429,000	0.71
1932	124,974,000	0.69	1937	129,252,000	0.64
1933	125,770,000	0.64	1938	130,215,000	0.74

The population estimates are those of the U. S. Bureau of the Census. See: U. S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States*, 1938, (Washington, 1939), p. 10.

(3) TABLE 3.—*Business gross capital formation, capital consumption, and net capital formation, 1924 to 1938 (millions of 1929 dollars)*

Year	Flow of producers' durable commodities (1)	Business construction (2)	Gross capital formation (1)+(2) (3)	Business capital consumption (4)	Net capital formation (3)−(4) (5)
1924	4,838	3,408	8,246	5,909	2,337
1925	5,368	4,026	9,394	6,112	3,282
1926	5,761	4,325	10,086	6,671	3,415
1927	5,993	4,467	10,460	6,557	3,903
1928	6,083	4,391	10,474	6,818	3,656
1929	6,891	4,581	11,472	7,134	4,338
1930	5,791	3,884	9,675	7,084	2,591
1931	4,012	2,481	6,493	6,951	−458
1932	2,601	1,332	3,933	6,533	−2,600
1933	2,779	1,166	3,945	6,315	−2,370
1934	3,811	1,404	5,215	6,143	−928
1935	4,583	1,742	6,325	6,162	163
1936	6,080	2,104	8,184	6,269	1,915
1937	6,987	2,726	9,713	6,437	3,276
1938	5,243	2,123	7,366		
Total 1924 to 1929					20,931
Total 1930 to 1935					−3,602

The above figures are estimates of Dr. Simon Kuznets of the National Bureau of Economic Research. See: Simon Kuznets, *National Income and Capital Formation, 1919–1935*, (New York, 1937) pp. 40 and 48, and Simon Kuznets, *Commodity Flow and Capital Formation in the Recent Recovery and Decline, 1932–1938*, Bulletin 74 of the National Bureau of Economic Research, (New York, June 25, 1939), p. 2.

The figures in columns (1) and (2) of the above table represent respectively production of business equipment and business plant; column (3) is the sum of columns (1) and (2). Column (4) is the total of depreciation, depletion, and fire and marine loss of business plant and equipment. Column (5) is the excess of column (3) over column (4) and represents the excess of production of business plant and equipment over consumption.

(4) TABLE 4.—*Net earnings of corporations, 1919–1937*

[millions of dollars]

Year	Net earnings	Year	Net earnings
1919	6,419	1929	8,083
1920	4,468	1930	1,366
1921	[1] 55	1931	[1] 3,145
1922	4,380	1932	[1] 5,375
1923	5,867	1933	[1] 2,379
1924	4,998	1934	157
1925	6,971	1935	1,674
1926	6,774	1936	3,903
1927	5,880	1937	3,872
1928	7,566		

[1] =Deficit.

The above profit estimates were based on federal income tax returns of all reporting corporations. Net earnings are defined—for the years 1919 to 1935—as net income less deficit of all reporting corporations less the total federal tax plus tax exempt interest. For 1936 and 1937 net earnings are equal to net income less deficit less the federal tax less dividends received from domestic corporations plus wholly tax exempt interest. See: U. S. Treasury Department, Bureau of Internal Revenue, *Statistics of Income for 1936, Part 2*, pp. 24, and 47. The figures for interest on tax-exempt obligations were obtained from Mr. Edward White of the Bureau of Internal Revenue in a letter dated July 14, 1939. Figures for 1937 are from a preliminary release (Press Service, No. 18–55) of the U. S. Treasury Department dated August 23, 1939.

(5) In addition to there being inadequate profit incentive there had also been little necessity that business make capital expenditures in order to meet current demands on productive capacity. In none of the six years 1930 to 1935 had industrial production averaged more than four-fifths of the 1929 figure, and in the low year, 1932, it had been only about one-half. See Table 5. Thus, industry's stock of plant and equipment was more than adequate to meet the demands on it in these years. There was obviously no necessity for making capital outlays to *expand* capacity, and the current level of operations was so low that little replacement expenditures to *maintain* capacity were required.

(6) TABLE 5.—*Federal Reserve Board Indexes of Production (1923–25=100)*

Date	Industrial Production		Manufacturing Production					
			Combined Index		Durable Goods		Non-durable Goods	
	Seasonally adjusted	Without seasonal adjustment	Seasonally adjusted	Without seasonal adjustment	Seasonally adjusted	Without seasonal adjustment	Seasonally adjusted	Without seasonal adjustment
Monthly Average:								
1929	119	119	119	119	122	122	117	117
1930	96	96	95	95	89	89	101	101
1931	81	81	80	80	59	59	99	99
1932	64	64	63	63	33	33	88	88
1933	76	76	75	75	50	50	98	98
1934	79	79	78	78	57	57	97	97
1935	90	90	90	90	76	76	102	102
1936								
Jan.	97	96	96	95	84	80	106	107
Feb.	94	95	92	93	79	79	103	105
Mar.	93	96	93	97	82	89	102	103
Apr.	101	104	100	105	94	105	104	105
May	101	105	101	105	98	107	104	104
June	104	104	105	105	102	105	107	105
July	108	105	109	105	107	103	112	107
Aug.	108	106	110	106	105	102	113	110
Sept.	109	108	110	107	106	97	114	116
Oct.	110	111	111	110	109	104	112	116
Nov.	114	115	115	115	112	109	117	120
Dec.	121	114	121	114	116	108	126	120
Monthly Average	105	105	105	105	99	99	110	110

(6) TABLE 5.—*Federal Reserve Board Indexes of Production (1923–25=100)*—Continued

Date	Industrial Production		Manufacturing Production					
			Combined Index		Durable Goods		Non-durable Goods	
	Seasonally adjusted	Without seasonal adjustment	Seasonally adjusted	Without seasonal adjustment	Seasonally adjusted	Without seasonal adjustment	Seasonally adjusted	Without seasonal adjustment
1937								
Jan.	114	112	115	113	112	107	117	118
Feb.	116	117	116	118	113	114	119	122
Mar.	118	122	117	122	113	123	120	121
Apr.	118	122	118	125	117	130	119	120
May	118	122	118	123	120	132	116	116
June	114	115	114	114	112	116	115	113
July	114	111	114	110	122	118	108	104
Aug.	117	115	117	114	126	122	110	107
Sept.	111	109	110	106	114	103	107	109
Oct.	102	102	101	99	101	94	100	103
Nov.	88	90	85	86	74	74	94	97
Dec.	84	80	79	75	60	57	95	90
Monthly Average	110	110	109	109	107	107	110	110
1938								
Jan.	80	79	76	75	56	53	93	94
Feb.	79	79	75	76	54	54	94	95
Mar.	79	80	75	77	54	57	93	94
Apr.	77	78	73	76	53	58	91	91
May	76	77	73	75	51	56	93	93
June	77	77	74	75	50	53	95	94
July	83	81	82	79	58	58	102	97
Aug.	88	87	87	85	64	63	108	104
Sept.	90	91	89	89	69	66	107	109
Oct.	96	97	95	95	83	79	106	109
Nov.	103	104	103	103	94	92	110	113
Dec.	104	98	104	98	92	85	114	108
Monthly Average	86	86	84	84	65	65	100	100
1939								
Jan.	101	99	100	98	88	84	110	111
Feb.	99	99	97	98	83	83	109	111
Mar.	98	100	96	100	80	86	110	111
Apr.	92	95	92	96	76	84	106	106
May	92	94	91	94	71	78	108	107
June	98	98	97	97	82	85	110	108
July	101	97	100	95	88	83	110	105
Aug.	[1] 102	[1] 99	[1] 104	[1] 99	[1] 93	[1] 86	[1] 114	[1] 111

[1] Preliminary.

See: *Survey of Current Business, 1938 Supplement*, pp. 7–8, March 1939, pp. 14 and 19, and *The Federal Reserve Bulletin*, October, 1939, pp. 914–916.

(7) TABLE 6.—*Consumers' Income and Outlay, 1929–1938*

[Billions of dollars]

Year	Consumers' income		Consumers' outlay	
	(current dollars)	(1929 dollars)	(current dollars)	(1929 dollars)
1929	$78.6	$78.6	$73.3	$73.3
1930	73.4	76.0	69.1	70.6
1931	63.1	72.4	56.3	62.9
1932	49.6	63.8	44.1	54.4
1933	45.9	61.4	42.3	55.3
1934	52.2	65.8	49.7	----------
1935	56.1	68.0	52.2	----------
1936	64.4	76.0	58.9	----------
1937	69.0	78.1	62.5	----------
1938	64.2	74.4	----------	----------

The figures for consumers' income (in current dollars) are those of the U. S. Department of Commerce for national income payments. See: Robert R. Nathan, *Income in the United States, 1929–1937* (U. S. Dept. of Commerce, November 1938) pp. 29–30; and the *Survey of Current Business*, March 1939, p. 19. The annual figures shown in Table 6 are sums of monthly figures reported by the U. S. Dept. of Commerce. Consumers' income in 1929 dollars was obtained by dividing consumers' income in current dollars by the National Industrial Conference Board's index of the cost of living with base 1929=100. See: *Survey of Current Business, 1938 Supplement*, p. 11, and March 1939, p. 20.

The consumers' outlay estimates are those of Dr. Simon Kuznets of the National Bureau of Economic Research. See: Simon Kuznets, *National Income and Capital Formation, 1919–1935* (New York, 1937) p. 85. The figures for 1934–1937 were reported by Dr. Alvin Hansen before the Temporary National Economic Committee on May 16, 1939.

(*8*) For an exhaustive study of the demand for automobiles see: C. F. Roos and Victor von Szeliski, "Factors Governing Changes in Domestic Automobile Demand," in *The Dynamics of Automobile Demand* published by the General Motors Corporation (New York, 1939).

(*9*) See: Roos and von Szeliski, *op. cit.* Chart 21 on page 60.

(*10*) See: Roos and von Szeliski, *op. cit.* Chart 15, p. 53.

(*11*) TABLE 7.—*Consumers' Expenditures for Durable Household Goods, 1929–1937*

[Millions of 1929 dollars]

Year	Consumers' Expenditure for Durable Household Goods	Year	Consumers' Expenditure for Durable Household Goods
1929	5,910	1934	4,010
1930	5,130	1935	4,670
1931	4,490	1936	5,900
1932	3,360	1937	6,330
1933	3,320		

These estimates are those of Mr. George Terborgh of the Division of Research and Statistics of the Board of Governors of the Federal Reserve System and reported (June, 1938) in his memoranda on "The Prospects for Durable Goods."

(*12*) TABLE 8.—*Gross and Net Capital Formation Arising in Residential Construction, 1924–1938*

[Millions of 1929 dollars]

Year	Residential Construction	Excess of Residential Construction over Consumption	Year	Residential Construction	Excess of Residential Construction over Consumption
1924	4,589	2,544	1932	600	−1,867
1925	5,218	3,079	1933	548	−1,899
1926	4,757	2,518	1934	595	−1,838
1927	4,515	2,182	1935	1,193	−1,214
1928	4,268	1,854	1936	1,965	−441
1929	3,010	530	1937	2,193	−226
1930	1,865	−646	1938	1,949	
1931	1,506	−984			

These are estimates of Dr. Simon Kuznets; see note (3) for source.

(13) TABLE 9.—*Indexes of Rent and Residential Construction Costs*

[1929=100]

Date	Rent Index	Construction Costs Indexes: Residences (E. H. Boeckh and Associates, Inc.)							
		Brick				Frame			
		Atlanta	New York	San Francisco	St. Louis	Atlanta	New York	San Francisco	St. Louis
Monthly average:									
1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1933	69.3	81.3	64.5	84.9	79.6	81.1	60.5	78.7	74.2
1934	70.4	89.5	73.0	101.6	89.4	88.7	69.8	96.5	82.8
1935	76.4	87.1	67.9	102.2	83.7	85.6	65.1	97.2	77.0
1936									
Jan	80.3	85.9	69.5	101.8	82.6	83.8	67.4	96.8	76.2
Feb	80.5	87.7	70.4	103.8	83.2	85.9	68.5	98.4	77.0
Mar	81.2	89.5	70.4	104.1	84.9	87.0	68.5	98.8	78.2
Apr	82.5	89.5	71.2	104.1	84.9	87.0	68.9	98.8	78.2
May	83.8	88.9	71.2	102.9	85.5	86.4	68.9	97.7	79.0
June	84.3	87.5	71.9	103.4	85.5	84.7	69.3	98.0	79.0
July	84.9	86.6	71.9	103.4	85.0	84.2	69.3	98.0	78.3
Aug	86.2	86.6	72.6	108.9	84.0	84.2	70.0	101.0	77.2
Sept	87.3	87.0	72.6	109.2	84.0	84.8	70.0	101.6	77.2
Oct	87.8	88.9	72.6	109.6	83.7	85.3	70.0	102.1	77.7
Nov	88.5	89.1	72.7	109.9	85.2	87.8	70.0	102.3	78.4
Dec	88.9	90.0	73.2	109.9	85.2	88.7	70.5	102.3	78.4
Monthly Average	84.7	88.1	71.7	10[illegible].9	84.6	86.1	69.3	99.7	78.0
1937									
Jan	89.3	93.6	74.4	113.4	88.1	94.1	71.9	106.1	81.6
Feb	90.0	95.8	75.8	108.6	88.9	96.1	73.6	106.1	82.6
Mar	91.5	98.5	76.5	110.5	89.2	98.0	74.6	108.2	82.9
Apr	92.6	103.3	76.5	112.2	89.8	103.8	74.6	110.2	83.3
May	93.6	103.3	76.8	112.2	89.7	103.8	74.7	110.2	83.2
June	94.1	103.2	83.4	116.2	91.3	103.3	81.8	110.9	84.3
July	94.7	99.9	84.9	116.2	90.6	99.4	82.6	110.9	83.5
Aug	95.4	100.1	85.1	123.1	90.1	99.6	82.8	120.7	82.9
Sept	96.3	100.4	86.5	122.5	92.3	99.9	84.2	119.9	85.5
Oct	97.0	99.3	84.1	118.3	91.6	98.4	81.3	112.0	84.6
Nov	96.8	99.3	83.5	118.3	90.9	98.4	80.7	112.0	83.9
Dec	96.4	96.8	83.0	114.5	90.3	95.9	80.5	108.1	82.9
Monthly Average	94.0	99.4	80.9	115.5	90.3	99.2	78.6	111.3	83.4
1938									
Jan	95.9	96.4	81.8	116.2	89.2	95.9	80.6	112.4	83.8
Feb	95.4	99.1	85.1	117.7	91.6	102.1	84.4	114.5	87.6
Mar	95.1	99.1	84.3	116.2	91.6	102.1	84.0	112.4	87.6
Apr	94.8	97.8	84.3	116.2	91.6	101.8	84.0	112.4	87.6
May	94.6	97.2	84.5	116.6	91.4	100.9	84.1	112.1	87.3
June	94.2	98.5	84.7	116.6	90.5	101.5	84.5	112.1	87.3
July	94.1	99.6	84.6	116.7	90.9	103.1	84.9	112.2	87.8
Aug	94.1	100.0	85.4	116.7	92.1	103.3	85.3	112.2	89.3
Sept	94.1	100.0	85.8	116.7	92.1	103.3	85.7	112.2	89.3
Oct	94.1	100.5	85.6	116.7	93.1	103.9	85.6	112.2	90.5
Nov	93.9	102.1	85.5	116.7	94.0	106.1	86.2	112.2	91.8
Dec	93.7	100.8	85.5	116.7	94.0	104.3	86.2	112.2	91.8
Monthly Average	94.5	99.3	84.8	116.6	91.8	102.4	84.6	112.4	88.5
1939									
Jan	93.7	99.3	85.5	118.1	93.7	102.4	86.3	113.6	96.4
Feb	93.6	100.1	85.3	118.1	93.7	103.5	86.1	113.6	96.4
Mar	93.6	99.3	85.3	118.1	93.4	102.4	86.1	113.6	96.0
Apr	93.7	99.3	85.5	118.1	93.4	102.4	86.3	113.6	96.0
May	93.7	100.6	86.0	115.9	93.4	103.9	86.7	113.6	96.0
June	93.5	101.4	86.0	115.9	93.1	105.0	86.7	113.6	95.6
July	93.8	101.1	86.3	115.9	92.2	104.5	86.8	113.6	94.4

The rent index is that of the National Industrial Conference Board with base shifted from 1923 to 1929. See: *Survey of Current Business, 1938 Supplement*, p. 11, March 1939, p. 20 and September 1939, p. 20. The construction costs indexes are those of E. H. Boeckh and Associates, Inc., and are based on actual contractors' records of wages and material costs. The base of the Boeckh indexes has been shifted to 1929. See: *Survey of Current Business, 1938 Supplement*, p. 22, March 1939, p. 22 and September 1939, p. 22.

(*14*) See: "Explanation of Method of Compiling Net Contribution," a memorandum of the Division of Research and Statistics of the Board of Governors of the Federal Reserve System dated February 10, 1939.

(*15*) The gross federal debt outstanding at the end of March 1933 was 21.4 billion dollars. By the end of December 1935 it had increased 9.2 billions to a total of 30.6 billion dollars. See: *Survey of Current Business, 1936 Supplement*, p. 55, and *1938 Supplement*, p. 65.

(*16*) The Standard Statistics Co., Inc. combined index of the prices of 420 industrial, railroad and public utility stocks stood at 64.6 (1926=100) in March, 1935. In March, 1936 the index stood at 108.7, an increase of about 70 per cent over March, 1935. See: *Survey of Current Business, 1938 Supplement*, p. 77.

(*17*) TABLE 10.—*Monthly indexes of consumers' income, 1936–1939*

[1929=100]

Date	U. S. Dept. of Commerce Index of Monthly Income Payments		Cost of Living	Real Consumers' Income	
	Adjusted for seasonal variation (1)	Unadjusted for seasonal variation (2)	(3)	Adjusted for seasonal variation (4)	Unadjusted for seasonal variation (5)
1936					
Jan.	75.6	76.9	83.8	90.2	91.8
Feb.	75.9	72.1	83.4	91.0	86.5
Mar.	76.7	76.2	83.1	92.3	91.7
Apr.	77.0	77.9	83.3	92.4	93.5
May	77.6	75.1	83.7	92.7	89.7
June	91.2	92.1	85.0	107.3	108.4
July	86.7	86.3	85.1	101.9	101.4
Aug.	82.0	75.9	85.5	95.9	88.8
Sept.	81.5	83.3	85.8	95.0	97.1
Oct.	82.5	86.7	85.6	96.4	101.3
Nov.	83.9	80.6	85.7	97.9	94.0
Dec.	85.9	100.0	86.0	99.9	116.3
Monthly Average	81.9	81.9	84.7	96.7	96.7
1937					
Jan.	85.4	84.6	86.8	98.4	97.5
Feb.	86.4	79.2	87.1	99.2	90.9
Mar.	88.3	86.6	87.8	100.6	98.6
Apr.	88.3	88.3	88.2	100.1	100.1
May	88.2	83.7	88.7	99.4	94.4
June	88.8	92.2	88.8	100.0	103.8
July	89.3	89.8	88.8	100.6	101.1
Aug.	90.2	83.8	88.9	101.5	94.3
Sept.	88.7	91.8	89.3	99.3	102.8
Oct.	88.0	92.2	89.4	98.4	103.1
Nov.	86.5	82.5	88.9	97.3	92.8
Dec.	85.8	98.6	88.5	96.9	111.4
Monthly Average	87.8	87.8	88.4	99.3	99.3
1938					
Jan.	83.5	83.7	87.4	95.5	95.8
Feb.	82.6	76.0	86.6	95.4	87.8
Mar.	82.7	81.4	86.6	95.5	94.0
Apr.	81.4	81.6	86.7	93.9	94.1
May	80.4	76.7	86.4	93.1	88.8
June	80.7	82.3	86.6	93.2	95.0
July	80.7	81.0	86.4	93.4	93.8
Aug.	81.5	76.1	85.8	95.0	88.7
Sept.	82.0	83.5	85.8	95.6	97.3
Oct.	82.1	86.3	85.7	95.8	100.7
Nov.	83.2	80.9	85.5	97.3	94.6
Dec.	84.1	90.9	85.7	98.1	106.1
Monthly Average	82.1	81.7	86.3	95.1	94.7
1939					
Jan.	83.7	84.3	85.3	98.1	98.8
Feb.	83.5	77.8	85.0	98.2	91.5
Mar.	84.2	84.3	84.8	99.3	99.4
Apr.	82.7	83.0	84.9	97.4	97.8
May	82.8	79.6	84.7	97.8	94.0
June	83.5	87.2	84.6	98.7	103.1
July	83.5	83.9	84.8	98.5	98.9

Real consumers' income was obtained by dividing the indexes of monthly income payments by the index of the cost of living. For the indexes of monthly income payments see: Robert R. Nathan, *Income in the United States, 1929–37* (Washington, November 1938) a bulletin of the U. S. Bureau of Foreign and Domestic Commerce, and the *Survey of Current Business*, July 1939, p. 19, and September 1939, p. 19. The cost of living index is that of the National Industrial Conference Board with base shifted to 1929. See: *Survey of Current Business, 1938 Supplement*, p. 11, March 1939, p. 20, and September 1939, p. 20.

NOTE.—The U. S. Department of Commerce index of monthly income payments has recently been revised. See *Survey of Current Business*, October, 1939, pp. 15–16, and 19.

(*18*) TABLE 11.—*U. S. Bureau of Labor Statistics indexes of wholesale prices, 1936–1939*

[1926=100]

Date	Grains	Raw Materials	Finished Products	Semimanufactures
1936				
Jan.	78.9	78.1	82.4	74.8
Feb.	78.3	79.1	82.2	74.6
Mar.	75.6	77.4	81.3	74.4
Apr.	73.9	77.0	81.6	74.5
May	70.6	75.8	80.5	74.1
June	73.0	77.6	80.7	73.9
July	88.9	79.8	81.6	75.2
Aug.	102.4	81.5	82.4	75.6
Sept.	102.0	81.8	82.3	75.9
Oct.	102.1	82.1	82.0	76.2
Nov.	102.9	83.1	82.6	78.6
Dec.	109.0	85.6	83.8	82.3
1937				
Jan.	113.0	88.1	84.9	85.4
Feb.	111.5	88.3	85.4	85.5
Mar.	113.2	90.1	86.4	89.6
Apr.	119.2	88.7	87.4	89.5
May	113.9	87.1	87.5	87.5
June	105.7	86.1	87.7	86.8
July	105.2	86.5	88.8	87.0
Aug.	92.0	84.8	89.0	86.6
Sept.	91.9	84.4	89.1	85.3
Oct.	77.0	80.7	88.1	82.5
Nov.	69.2	77.2	86.7	79.8
Dec.	71.5	75.4	85.3	77.7
1938				
Jan.	75.0	74.9	84.3	76.9
Feb.	73.0	73.6	83.3	76.1
Mar.	69.0	73.2	83.4	75.6
Apr.	66.0	71.3	82.7	75.3
May	62.3	70.7	82.1	75.4
June	62.7	71.4	82.2	74.1
July	58.3	72.3	82.5	74.3
Aug.	53.4	71.4	81.8	74.4
Sept.	53.0	72.0	81.8	74.7
Oct.	50.8	70.9	81.1	75.9
Nov.	50.9	71.5	80.5	76.2
Dec.	54.4	70.9	80.2	75.2
1939				
Jan.	56.3	70.9	80.0	74.9
Feb.	54.7	70.9	80.2	74.4
Mar.	54.5	70.1	80.2	74.6
Apr.	55.2	68.5	80.1	74.4
May	59.6	68.9	79.9	74.3
June	58.2	67.7	79.6	74.1
July	52.3	67.8	79.2	74.4

See: *Survey of Current Business, 1938 Supplement*, p. 12, March 1939, p. 20, and September 1939, p. 20.

(*19*) The following statement appeared in *The Iron Age*, November 19, 1936, p. 56:

"Most (automobile) companies have already made sales predictions for the 1937 model year, but if the present trend is continued these predictions will have to be revised . . . and, if upward revision in sales budgets continues, the industry may possibly eclipse the 5,621,000 record number of units set in 1929."

See also: *The Iron Age*, Sept. 3, 1936, p. 53; Nov. 12, 1936, pp. 57 and 91; and Jan. 7, 1937, pp. 73 and 98.

(*20*) See: Roos and von Szeliski, *op. cit.*, Chart 32, p. 74, and Chart 35, p. 81.

(*21*) See: *The Iron Age*, Nov. 12, 1936, p. 57; Nov. 19, 1936, p. 56; Dec. 10, 1936, p. 55; Dec. 17, 1936, p. 54; and *Steel*, Nov. 9, 1936, p. 33; and Nov. 16, 1936, p. 31.

(*22*) See statements in *The Iron Age*, Dec. 3, 1936, p. 62; Dec. 24, 1936, p. 47; Dec. 31, 1936, p. 63, and Jan. 7, 1937, p. 99; and in *Steel*, Dec. 14, 1936, p. 24.

(*23*) TABLE 12

Quarter	Billed Sales of Electric Ranges ($000) (1)	Sales of Electric Household Refrigerators (number) (2)	Vacuum Cleaners (Floor Type) Shipments of (number) (3)
1935			
IV	$3,542	166,540	266,206
1936			
I	4,142	570,959	274,818
II	6,796	870,600	290,483
III	4,892	392,123	258,680
IV	4,852	245,853	325,511
1937			
I	6,941	769,705	352,956
II	9,093	936,045	368,590
III	6,130	396,137	282,261
IV	3,651	267,138	281,409
1938			
I	5,420	424,410	277,436
II	5,434	496,869	228,139
III	4,115	243,876	207,511
IV	3,310	114,047	280,977
1939			
I	6,596	600,280	288,678
II	6,359	803,018	272,202

(1) Compiled by the *National Electrical Manufacturers' Association* from data furnished by its members. Figures represent practically all of the output of electric ranges.

(2) Compiled by the *Edison Electric Institute*, based on estimates of the *National Electrical Manufacturers' Association* covering reports of its members only.

(3) Compiled by the *Vacuum Cleaners Manufacturers' Association*, representing practically the entire industry.

These three series are reported on monthly basis in the *Survey of Current Business, 1938 Supplement*, p. 141, March 1939, p. 51, and September 1939, p. 51.

(24) TABLE 13.—*Construction Activity Indexes*

Date	Federal Reserve Board Indexes of Value of Construction Contracts Awarded (1923–25=100)			
	Adjusted for seasonal variation		Unadjusted for seasonal variation	
	Residential	Total	Residential	Total
1929 Monthly Average	87	117	87	117
1936				
Jan	25	62	21	50
Feb	25	52	22	45
Mar	26	47	28	47
Apr	30	47	35	53
May	32	46	38	56
June	36	52	39	60
July	44	59	45	65
Aug	46	62	46	65
Sept	47	59	47	60
Oct	43	57	41	54
Nov	40	58	39	51
Dec	45	66	38	53
Monthly Average	37	55	37	55
1937				
Jan	45	63	37	51
Feb	47	62	42	54
Mar	45	56	47	56
Apr	44	53	51	61
May	44	56	52	68
June	42	61	47	72
July	44	67	45	75
Aug	40	62	40	66
Sept	37	56	37	56
Oct	36	52	35	49
Nov	32	56	31	50
Dec	30	61	25	49
Monthly Average	41	59	41	59
1938				
Jan	26	52	22	42
Feb	32	51	28	44
Mar	33	46	35	46
Apr	37	52	43	59
May	37	51	44	61
June	42	54	46	63
July	49	59	49	65
Aug	53	66	52	69
Sept	56	78	56	79
Oct	57	82	56	78
Nov	56	96	54	85
Dec	57	96	48	77
Monthly Average	44	64	44	64
1939				
Jan	55	86	45	70
Feb	58	73	51	63
Mar	55	69	58	69
Apr	58	67	68	76
May	65	63	65	75
June	58	63	64	73
July	62	67	63	73
Aug	[1] 64	[1] 73	[1] 64	[1] 77

[1] Preliminary.

The Federal Reserve Board indexes are based on reports of the F. W. Dodge Corporation for 37 states east of the Rocky Mountains. See: *Survey of Current Business, 1938 Supplement*, p. 16, and March 1939, p. 21. Data for 1939 are from *The Federal Reserve Bulletin*, October 1939, p. 914.

(*25*) TABLE 14.—*Railroad activity*

Date	Federal Reserve Board Indexes of Freight Car Loadings (Combined Index) (1923–25=100)		Freight Car Surplus (000's of cars)	Revenue Passengers Carried One Mile (Class I Railways) (000,000's)	Net Railway Operating Income (Class I Railways) ($000)	Net Income (Class I Railways) ($000)
	Adjusted for seasonal variation	Unadjusted for seasonal variation				
	(1)	(2)	(3)	(4)	(5)	(6)
1929 Monthly Average	107	107	235	2,590	$104,358	
1935						
Jan	63	59	342	1,491	21,935	[1] $21,390
Feb	66	62	320	1,341	26,296	[1] 17,830
Mar	65	63	300	1,370	38,130	[1] 4,162
Apr	62	59	310	1,385	34,709	[1] 8,167
May	61	60	305	1,377	39,599	[1] 4,668
June	64	63	272	1,593	34,103	[1] 5,354
July	59	59	296	1,709	26,919	[1] 15,961
Aug	63	64	245	1,855	42,157	[1] 2,305
Sept	64	71	229	1,659	57,349	13,635
Oct	68	75	208	1,475	75,455	31,381
Nov	68	69	252	1,436	54,224	9,980
Dec	68	64	271	1,787	46,021	21,648
Monthly Average	64	64	279	1,540	41,408	[1] 115
1936						
Jan	70	65	231	1,689	35,729	[1] 7,781
Feb	71	68	171	1,582	33,562	[1] 11,582
Mar	66	64	205	1,539	35,152	[1] 8,213
Apr	71	68	179	1,577	41,493	[1] 2,193
May	72	71	185	1,579	41,797	[1] 2,308
June	73	73	170	1,944	50,259	9,004
July	76	77	147	2,264	61,722	19,412
Aug	76	77	146	2,311	64,637	20,980
Sept	75	84	125	2,065	70,096	26,482
Oct	77	86	112	1,912	89,809	46,585
Nov	82	84	121	1,798	72,377	30,194
Dec	83	77	133	2,164	70,506	49,150
Monthly Average	75	75	161	1,869	55,595	13,790
1937						
Jan	80	73	131	2,030	38,867	[1] 4,502
Feb	82	76	113	1,797	38,784	[1] 4,996
Mar	83	80	113	1,921	69,881	24,889
Apr	84	79	134	1,856	48,358	3,824
May	80	80	147	1,902	44,239	[1] 1,322
June	78	79	137	2,164	59,354	18,560
July	80	82	137	2,438	60,558	19,007
Aug	79	81	127	2,429	50,308	6,347
Sept	78	87	104	2,200	59,305	16,210
Oct	76	84	123	1,977	60,747	17,195
Nov	71	72	219	1,817	32,441	[1] 6,566
Dec	67	62	283	2,127	25,972	5,947
Monthly Average	78	78	147	2,055	49,068	[1] 8,103
1938						
Jan	65	59	299	1,981	7,144	[1] 33,476
Feb	62	57	321	1,648	[1] 2,122	[1] 44,567
Mar	60	57	312	1,649	14,470	[1] 28,212
Apr	57	55	317	1,712	9,237	[1] 33,483
May	58	57	328	1,683	16,497	[1] 25,503
June	58	58	316	1,889	25,001	[1] 15,954
July	61	62	256	2,118	38,387	[1] 3,955

[1] Deficit.

(1) and (2). Computed by the Federal Reserve Board from weekly data reported by the *Association of American Railroads*.

(3). Compiled by the *Association of American Railroads, Car Service Division*. Data cover Class I railroads and represent a daily average for the last half of the month.

(4), (5) and (6). Compiled by the *Interstate Commerce Commission*.

(*25*) TABLE 14.—*Railroad activity*—Continued

Date	Federal Reserve Board Indexes of Freight Car Loadings (Combined Index) (1923-25=100)		Freight Car Surplus (000's of cars)	Revenue Passengers Carried One Mile (Class I Railways) (000,000's)	Net Railway Operating Income (Class I Railways) ($000)	Net Income (Class I Railways) ($000)
	Adjusted for seasonal variation	Unadjusted for seasonal variation				
	(1)	(2)	(3)	(4)	(5)	(6)
1938						
Aug.	62	63	229	1,976	45,377	1,097
Sept.	64	71	169	1,825	50,362	6,277
Oct.	68	75	144	1,662	68,566	24,068
Nov.	69	70	175	1,564	49,665	7,422
Dec.	69	64	221	1,928	49,373	[illegible]
Monthly Average	62	62	257	1,803	30,996	[1] 10,338
1939						
Jan.	69	63	218	1,790	32,891	[1] 8,721
Feb.	67	62	209	1,555	18,591	[1] 24,364
Mar.	66	63	202	1,618	34,317	[1] 10,505
Apr.	60	58	265	1,681	15,257	[1] 27,896
May	62	62	211	1,725	25,101	[1] 18,594
June	67	67	175		39,095	[1] 1,685
July	69	70	166		49,012	

[1] Deficit.

These series are all reported in the *Survey of Current Business, 1938 Supplement*, pp. 84–86, March 1939, pp. 37–38, July 1939, p. 38, and September 1939, p. 37.

(*26*) TABLE 15.—*Corporation profits**

Quarter	Federal Reserve Bank of New York (168 industrials) (millions of dollars)	Standard Statistics Co., Inc., (119 industrials) (1926=100)	
		Seasonally adjusted	Seasonally unadjusted
1935			
I	$107.9	49.7	46.9
II	147.6	55.6	62.6
III	124.7	51.5	54.9
IV	199.8	92.7	81.3
1936			
I	170.0	75.2	71.0
II	269.2	96.0	108.1
III	217.2	83.6	89.2
IV	283.5	130.7	114.6
1937			
I	248.3	109.6	103.6
II	309.0	113.5	127.8
III	262.4	104.4	111.4
IV	194.9	92.8	81.4
1938			
I	74.0	38.7	36.6
II	84.4	35.8	40.4
III	61.8	32.2	34.4
IV	187.0	79.0	[illegible]
1939			
I	153.3	[illegible]	[illegible]
II		[illegible]	[1] 68.7

* Data are for net income after payment of fixed charges and taxes. All of the above series are reported in the *Survey of Current Business, 1938 Supplement*, p. 64, March 1939, p. 32, July 1939, p. 32, and September 1939, p. 32. See also Note 4.

[1] Preliminary.

(28) TABLE 16.—*New orders for products made from steel*

Date	Steel Boilers [1] (000's of sq. ft.)	Steel Office Furniture [2] ($000)	Steel Shelving [2] ($000)	Fabricated Steel Plate [4] (Short-Tons)	Air-conditioning Systems and Equipment [3] ($000)	Electric Overhead Cranes [6] ($000)	Foundry Equipment (Monthly Average Shipments [7] 1922-24=100)	Machine Tools Domestic and Export (Monthly Average Shipments [8] 1926=100)	Pumps: Steam, Power Centrifugal and Rotary [9] ($000)	Woodworking Machinery ($000) [10]	Electrical Goods [11] ($000,000)	Electric Motors (1-200 H. P.) AC and DC [12] ($000)	Power Switching Equipment (Indoor and outdoor) [12] ($000)	Railroad Freight Cars [13] (number)	Railroad Locomotives [13] (number)	Railroad Passenger Cars [13] (number)
Monthly Average:																
1929	1,590			53,223		$1,218	196.8	155.8	1,803	$1,560	$266	$4,529	$623	9,268	101	192
1930	1,083	$2,016	$672	39,120		589	105.0	70.9	1,324	744	203	3,407	494	3,863	37	56
1931	569	1,242	371	25,209		227	52.0	41.0	839	441	145	1,982	296	907	15	1
1932	292	659	177	13,483		42	19.4	19.6	505	176	71	921	79	164	1	3
1933	402	670	173	16,586		63	37.3	27.1	659	234	81	1,254	75	140	4	1
1934	364	988	268	20,166		127	60.5	46.2	743	249	110	1,589	123	2,051	15	32
1935	520	1,317	304	21,526		338	103.3	86.0	860	341	135	2,151	155	1,558	7	8
1936																
Jan	623	1,619	389	38,709	$2,358	626	127.0	110.8	1,168	449		2,336	133	1,050	18	32
Feb	810	1,427	325	27,863	2,680	349	110.4	112.1	1,392	412		2,488	219	7,236	46	37
March	590	1,667	419	30,437	3,571	363	115.0	105.3	1,224	417	153	2,719	224	627	13	0
April	784	1,583	378	30,018	3,444	572	134.0	125.7	1,323	377		2,789	282	3,650	15	50
May	712	1,514	414	51,443	4,651	889	165.4	118.9	1,237	439		3,152	240	9,677	10	0
June	1,131	1,565	448	52,937	4,556	281	141.4	128.8	1,361	445	191	3,523	216	4,320	24	20
July	1,110	1,511	394	60,324	4,377	404	159.6	150.1	1,392	474		3,235	322	4,469	9	34
Aug	1,081	1,517	448	31,999	3,734	539	145.4	127.5	1,580	571		3,310	251	3,225	3	0
Sept	892	1,587	433	35,033	3,509	479	161.0	118.5	1,233	652	191	3,573	299	3,100	24	0
Oct	969	1,841	436	33,791	4,401	416	174.4	136.5	1,327	561		3,081	367	1,310	22	5
Nov	937	1,734	459	40,465	3,834	529	200.4	147.1	1,161	737		3,221	282	1,710	174	50
Dec	1,872	2,227	670	51,017	4,400	1,136	283.3	257.7	1,690	744	228	4,893	400	19,922	91	34
Monthly Average	959	1,649	434	40,336	3,793	548	159.8	136.3	1,341	523	191	3,193	279	5,629	44	26
1937																
Jan	654	2,541	608	41,419	4,876	883	190.9	200.3	1,415	744		4,258	419	10,881	46	70
Feb	862	2,179	638	32,375	4,786	921	249.5	165.2	1,349	564		4,375	488	10,532	33	154
March	1,586	2,715	726	71,250	8,632	1,079	294.2	211.6	2,111	904	271	5,910	736	6,200	29	162
April	676	2,905	766	42,455	6,538	1,415	208.3	282.5	1,792	748		5,241	965	13,046	84	52
May	1,015	2,027	526	28,913	6,473	751	242.0	208.5	1,622	602		3,955	485	3,903	14	8
June	726	2,423	609	34,833	7,440	534	228.2	191.8	1,599	578	261	4,626	557	528	22	10
July	996	2,128	592	27,480	5,570	638	204.0	171.1	1,989	503		3,606	639	1,030	3	14

See footnotes at end of table.

(28) TABLE 16.—*New orders for products made from steel*—Continued

Date	Steel Boilers (000's of sq. ft.)	Steel Office Furniture ($000)	Steel Shelving ($000)	Fabricated Steel Plate (Short-Tons)	Air-conditioning Systems and Equipment ($000)	Electric Overhead Cranes ($000)	Foundry Equipment (Monthly Average Shipments 1922-24=100)	Machine Tools Domestic and Export (Monthly Average Shipments 1926=100)	Pumps: Steam, Power Centrifugal and Rotary ($000)	Woodworking Machinery ($000)	Electrical Goods ($000,000)	Electric Motors (1-200 H. P.) AC and DC ($000)	Power Switching Equipment (Indoor and outdoor) ($000)	Railroad Freight Cars (number)	Railroad Locomotives (number)	Railroad Passenger Cars (number)
1937																
Aug	937	1,773	541	31,763	4,033	1,452	257.5	179.8	1,990	637	......	3,657	489	1,490	39	1
Sept	679	2,072	582	31,484	3,911	1,216	232.1	210.7	1,518	491	216	3,755	461	1,195	8	0
Oct	636	1,895	493	31,942	3,891	486	185.3	152.0	1,410	679	......	3,396	363	21	0	0
Nov	610	1,945	511	27,507	3,121	274	128.1	127.7	1,236	395	......	2,435	489	1,625	13	13
Dec	547	2,124	400	27,463	2,948	215	113.7	142.7	1,074	334	182	2,650	329	1,350	1	0
Monthly Average	827	2,227	583	35,740	5,185	822	211.2	186.9	1,592	598	233	3,988	535	4,395	31	69
1938																
Jan	502	1,986	384	23,422	2,644	742	77.6	118.4	1,196	288	......	1,934	274	......	......	......
Feb	435	1,680	413	17,827	3,660	321	90.8	75.7	1,110	315	......	2,099	298	......	......	......
March	739	1,822	442	38,052	3,785	175	114.7	107.0	1,302	283	154	2,489	224	......	......	......
April	475	1,444	394	21,958	4,459	611	79.3	90.3	927	283	......	2,183	352	......	......	......
May	734	1,290	305	25,141	3,791	150	90.6	66.7	999	827	......	2,078	356	......	......	......
June	547	1,689	292	20,044	3,759	289	62.2	70.2	952	271	157	2,476	282	......	......	......
July	691	1,554	321	27,773	3,237	156	75.3	89.6	1,034	365	......	1,992	417	......	......	......
Aug	783	1,538	368	22,069	3,221	144	83.4	120.9	2,006	337	......	2,053	309	......	......	......
Sept	579	1,630	411	18,551	3,055	113	78.7	117.4	1,462	381	159	2,205	242	......	......	......
Oct	717	1,650	318	21,793	3,436	171	87.9	118.1	1,449	340	......	1,988	184	......	......	......
Nov	635	1,813	335	20,213	2,958	179	89.7	112.2	970	456	......	2,256	181	......	......	......
Dec	892	1,852	315	28,218	3,304	377	141.9	146.5	1,155	612	160	2,392	231	......	......	......
Monthly Average	644	1,662	358	23,755	3,442	286	89.3	102.8	1,214	355	158	2,179	279	......	......	......
1939																
Jan	1,131	1,966	368	20,511	......	168	122.5	150.8	1,204	363	......	2,114	161	......	......	......
Feb	817	1,782	388	22,903	......	201	135.5	167.1	1,282	410	......	2,166	271	......	......	......
Mar	617	1,798	499	29,784	......	284	146.6	185.4	1,258	445	198	3,095	284	......	......	......
Apr	765	1,619	399	35,844	......	823	146.2	155.6	1,230	393	......	2,608	354	......	......	......
May	877	1,780	507	34,036	......	438	108.9	219.8	1,236	484	......	2,747	436	......	......	......
June	1,032	1,902	420	33,959	......	274	134.9	211.6	1,673	417	206	3,053	310	......	......	......
July	772	1,737	400	31,364	......	383	114.0	230.9	......	435	......	......	374	......	......	......

[1] Compiled by the U. S. Department of Commerce, Bureau of the Census, and reported in the *Survey of Current Business, 1938 Supplement*, p. 134, and March 1939, p. 49. Data relate to boilers of 100 square feet of heating surface and over, and covers reports of 72 manufacturers in 1929, 68 in 1930–36, and 67 in 1937, the reduction resulting from mergers and from firms going out of business. The reporting manufacturers produce about 90 per cent of the output of the industry.

[2] Compiled by the U. S. Department of Commerce, Bureau of the Census, and reported in the *Survey of Current Business, 1938 Supplement*, p. 134, and March 1939, p. 49. Data include reports from 30 to 39 manufacturers, who produce over 90 per cent of the output. New orders are less cancellations and do not include professional, store, and beauty shop furniture.

[3] Compiled by the U. S. Department of Commerce, Bureau of the Census, and reported in the *Survey of Current Business, 1938 Supplement*, p 135, and March 1939, p. 49. Data include reports from 12 to 22 manufacturers producing about 90 per cent of the output. New orders are less cancellations.

[4] Compiled by the U. S. Department of Commerce, Bureau of the Census, and reported in the *Survey of Current Business, 1938 Supplement*, p. 135, and March 1939, p. 49. Data cover reports of most of the larger manufacturers.

[5] Compiled by the U. S. Department of Commerce, Bureau of the Census, and reported in the *Survey of Current Business, 1938 Supplement*, p. 139, and March 1939, p. 50. Data comprise reports from 125 manufacturers.

[6] Data furnished by the *Organization Service Corporation* from compilations by the *Electric Overhead Crane Institute* covering reports from manufacturers who produce about 98 per cent of the output of the industry. Series reported in the *Survey of Current Business, 1938 Supplement*, p. 139, and March 1939, p. 50.

[7] Compiled by the *Foundry Equipment Manufacturers' Association* from reports representing 65 to 70 per cent of the industry output. The reports for each month are related to the average shipments of the reporting firms from 1922 to 1924, and are thus comparable despite changes in the number of reporting firms. Data are reported in the *Survey of Current Business, 1938 Supplement*, p. 139, and March 1939. p. 50.

[8] Compiled by the *National Machine Tool Builders' Association*. Data represent dollar value of new orders and include forging machinery. The Association received reports from 60 to 89 companies in 1929 to 1933, 167 companies in 1934, 155 in 1935, 143 in 1936, 135 in 1937. The index has been adjusted for the increase in coverage in 1934. The series is reported in the *Survey of Current Business, 1938 Supplement*, p. 140, and March 1939, p. 50.

[9] Compiled by the *Hydraulic Institute* and reported in the *Survey of Current Business, 1938 Supplement*, p. 140, and March 1939, p. 50. Data represent reports from manufacturers who produce about 70 per cent of the output of the industry.

[10] Compiled by the *Association of Manufacturers of Woodworking Machinery* and reported in the *Survey of Current Business, 1938 Supplement*, p. 140, and March 1939, p. 50. The coverage varies somewhat from year to year. The coverage in 1929 was about 54 per cent, in 1933, 43 per cent, and in 1935 about 30 per cent.

[11] Compiled by the U. S. Department of Commerce, Bureau of the Census, and reported in the *Survey of Current Business, 1938 Supplement*, p. 141, and March 1939, p. 51. Data include reports from 78 manufacturers of electric motors, storage batteries, domestic appliances, industrial equipment, etc.

[12] Compiled by the *National Electrical Manufacturers' Association* and reported in the *Survey of Current Business, 1938 Supplement*, p. 141, and March 1939, p. 51. Coverage varies from year to year.

[13] Compiled by the *Railway Age*, and reported in the *Survey of Current Business, 1938 Supplement*, p. 162. Data comprise new orders placed by all buyers including private car-owning organizations as well as the railroads. Annual figures represent complete coverage, although in some months there may be incomplete reporting.

Figures for 1939 are from the *Survey of Current Business*, September 1939, pp. 49–51.

(*28*) See comments in *The Iron Age*, Nov. 19, 1936, p. 113; Dec. 3, 1936, p. 118; Dec. 10, 1936, p. 114; Dec. 24, 1936, p. 85; and Dec. 31, 1936, p. 89; and in *Steel*, Dec. 7, 1936, p. 114.

(*29*) TABLE 17.—*Business and Public Construction*

Date	Value of Construction Contracts Awarded ($000)					Value of Highway and Grade Crossing Projects Approved for Construction (Federal Funds) ($000)	
	Commercial buildings	Factory buildings	Public utilities	Public buildings	Public works	Highway	Grade crossings
Monthly Average:							
1929	$77,432	$45,488	$43,712	$10,065	$77,871	$16,667	----------
1930	51,360	21,386	58,393	11,651	80,251	24,441	----------
1931	25,925	9,680	24,639	15,106	72,954	41,073	----------
1932	10,227	3,624	6,300	9,832	42,892	35,172	----------
1933	8,281	10,626	8,600	4,242	41,626	44,273	----------
1934	12,550	9,673	10,516	4,639	52,087	52,448	----------
1935							
Jan	10,810	7,065	8,707	4,132	35,699	58,302	----------
Feb	9,207	7,761	3,885	4,843	23,933	60,076	----------
Mar	12,202	6,496	6,475	6,991	30,779	52,083	----------
Apr	15,197	6,284	7,319	3,079	33,170	41,088	----------
May	13,919	9,815	5,419	6,404	25,967	33,746	----------
June	15,021	9,468	9,146	7,672	29,991	26,208	----------
July	15,821	14,564	13,810	3,190	40,083	24,996	----------
Aug	17,326	10,649	4,422	14,188	65,118	33,711	$1,776
Sept	13,553	6,002	12,493	13,547	63,653	47,579	4,365
Oct	16,622	12,032	11,198	10,931	75,117	61,824	12,039
Nov	12,826	8,854	10,694	6,764	69,645	77,361	26,933
Dec	11,976	9,169	18,104	16,046	76,387	78,935	34,972
Monthly Average	13,707	9,013	9,306	8,149	48,212	49,659	----------
1936							
Jan	15,550	8,956	17,926	12,496	68,948	72,030	35,973
Feb	12,568	13,437	11,939	4,342	34,694	80,125	39,022
Mar	17,251	18,411	18,106	8,971	44,191	82,599	40,283
Apr	24,272	25,546	23,753	6,264	49,660	73,595	42,011
May	18,785	12,895	12,773	13,706	50,792	62,963	40,561
June	21,910	10,213	9,264	14,659	70,717	53,090	40,217
July	28,641	19,140	27,512	6,557	99,103	50,400	34,081
Aug	21,963	14,980	17,945	11,246	76,435	50,476	29,026
Sept	20,065	18,838	15,735	6,730	68,767	49,123	26,575
Oct	21,989	18,392	14,171	7,991	52,861	46,103	23,615
Nov	22,986	14,075	18,029	5,041	55,839	42,093	20,233
Dec	23,156	23,139	19,117	4,207	42,135	42,090	17,971
Monthly Average	20,761	16,502	17,189	8,517	59,512	58,724	32,464
1937							
Jan	21,463	37,028	21,788	5,533	46,664	43,899	16,037
Feb	22,295	12,609	32,364	4,952	27,264	44,472	13,526
Mar	30,007	22,248	20,256	11,090	32,221	46,856	12,859
Apr	28,540	30,051	20,985	8,163	44,757	47,081	13,688
May	25,610	18,539	10,763	9,220	55,980	48,569	14,129
June	24,488	36,822	29,863	10,827	70,064	49,263	15,730
July	29,112	58,501	49,992	11,255	52,501	43,417	12,323
Aug	29,590	37,875	27,455	9,982	63,103	40,606	11,761
Sept	25,333	12,934	12,949	6,597	52,873	39,849	12,713
Oct	25,238	12,640	15,602	9,179	45,982	39,112	10,883
Nov	18,855	13,504	17,426	9,798	43,983	39,781	10,731
Dec	16,513	20,940	18,286	8,305	46,475	41,683	10,443
Monthly Average	24,754	26,141	23,144	8,742	48,489	43,716	12,902

(*29*) TABLE 17.—*Business and Public Construction*—Continued

Date	Value of Construction Contracts Awarded ($000)					Value of Highway and Grade Crossing Projects Approved for Construction (Federal Funds) ($000)	
	Commercial buildings	Factory buildings	Public utilities	Public buildings	Public works	Highway	Grade crossings
1938							
Jan.	*15.40	* 6.59	48,451	----------	50,125	42,149	10,433
Feb.	*13.04	* 4.92	5,149	----------	25,333	41,407	11,392
Mar.	*20.20	*15.68	10,694	----------	49,005	40,636	13,577
Apr.	*18.94	*11.47	9,373	----------	57,631	44,072	12,419
May	*19.17	* 8.65	43,699	----------	78,533	51,158	10,690
June	*18.79	*10.68	8,689	----------	74,832	51,299	12,090
July	*26.15	* 9.69	13,431	----------	65,827	53,137	12,836
Aug.	*18.33	*11.31	37,980	----------	88,113	48,958	11,416
Sept.	*13.96	*10.74	26,167	----------	83,162	43,373	12,561
Oct.	*24.17	*13.79	21,176	----------	92,829	38,572	12,112
Nov.	*13.72	*10.53	19,726	----------	70,692	36,231	13,930
Dec.	*13.96	* 7.03	44,312	----------	114,075	37,677	12,794
Monthly Average	*17.99	*10.09	24,071	----------	70,846	44,057	12,188
1939							
Jan.	----------	----------	29,509	----------	57,002	36,294	13,572
Feb.	----------	----------	18,518	----------	53,115	35,968	13,613
Mar.	----------	----------	19,640	----------	58,010	34,969	12,906
Apr.	----------	----------	35,336	----------	85,633	35,600	12,107
May	----------	----------	21,779	----------	76,141	40,769	10,224
June	----------	----------	9,968	----------	73,607	41,024	11,312
July	----------	----------	23,092	----------	78,960	37,802	11,504

* In millions of Dollars.

The series showing value of construction contracts awarded are compiled by the F. W. Dodge Corporation and cover 37 states east of the Rocky Mountains. The coverage of the data varies somewhat from year to year. See the *1938 Supplement* of the *Survey of Current Business*, p. 169, for description of the series. Figures for highways and grade crossing projects are those of the U. S. Department of Agriculture, Bureau of Public Roads, and are condition figures as of the end of the month for highway work administered by the Bureau.

All of the series of Table 17 are reported in the *Survey of Current Business, 1938 Supplement*, pp. 16-20; March, 1939, pp. 21–22 and September, 1939, pp. 21-22 and *Standard Trade and Securities, Current Statistics*, July 14, 1939, p. 21 (Published by the Standard Statistics Co., Inc.)

(*30*) See table 1, and Table 19 in note 38.

(*31*) Throughout July and August expectations of near future price advances were becoming strong. See the statements in *The Iron Age*, July 30, 1936, p. 55; August 6, 1936, p. 71; Aug. 13, 1936, p. 89; Aug. 20, 1936, p. 73; and Aug. 27, 1936, pp. 71 and 79.

(*32*) See the comments in *The Iron Age*, May 28, 1936, pp. 84 and 86; June 11, 1936, pp. 80, 82, 85, 88 and 90; and June 18, 1936, pp. 51 and 72. The following statement appeared on page 102 of the June 25, 1936 issue:

"Of even more practical significance is the fact that fully half of the steel tonnage booked during June has been prompted by price advances."

(*33*) See Table 1.

(*34*) See Table 1, and note 38. See also the statements in *The Iron Age*, for Sept. 10, 1936, p. 93; Sept. 17, 1936, p. 93; Sept. 24, 1936, p. 75; Oct. 1, 1936, p. 73; Oct. 22, 1936, p. 71; and Oct. 29, 1936, pp. 67–A and 70. The price advances early in September were effective for the fourth quarter. Advance announcement of the price increases undoubtedly caused some protective forward buying in the last half of September.

(*35*) See note 18, Table 11.

(*36*) TABLE 18.—*Composite Price of No. 1 Heavy Melting Steel Scrap*

[Dollars per gross ton]

Date	1936	1937	1938	1939
Jan	13.47	18.33	14.00	15.00
Feb	14.12	19.27	13.86	15.00
Mar	14.75	21.25	13.46	15.17
Apr	14.59	21.02	12.40	14.42
May	13.39	18.54	11.54	14.08
June	12.81	17.28	11.32	14.75
July	13.29	18.79	13.29	15.04
Aug	15.04	20.43	14.51	15.46
Sept	16.45	18.73	14.34	19.25
Oct	16.63	15.89	14.21	
Nov	16.31	13.34	14.74	
Dec	17.10	13.46	14.88	
Monthly Average	14.75	18.03	13.54	

The above steel scrap composite price is that computed by *The Iron Age*, and is an average of Pittsburgh, Chicago, and Philadelphia quotations. See: *The Iron Age*, January 5, 1939, p. 205. The figures for 1939 are for the middle week of the respective months, and were obtained from current issues of *The Iron Age*.

(*37*) Employee Representation Plans had been set up in 1934, 1935 and 1936 in many of the leading steel plants. In the summer and autumn of 1936, the number of employees enrolled in these labor organizations had grown greatly. Negotiations concerned with the question of wages were carried on between steel employers and E. R. P. representatives during most of the summer and fall. These negotiations and the possibilities of future labor difficulties led to widespread expectations of a rise in steel wage rates. The developments of the summer and autumn of 1936, can be followed in statements in *The Iron Age*, Aug. 6, 1936, p. 71; Oct. 22, 1936, p. 71; Oct. 29, 1936, pp. 67–A and 70; Nov. 12, 1936, pp. 72–78 and 91; Nov. 19, 1936, p. 76, and other issues from July to November.

(*38*) Appendix Table 19 below shows the announced prices and announced effective dates at Pittsburgh and Chicago of several steel products of United States Steel Corporation.

See also: Table 1, and the comments in *The Iron Age*, Nov. 26, 1936, pp. 77, 88; Dec. 3, 1936, p. 105; and Dec. 17, 1936, p. 85.

TABLE 19.—*Announced Prices with Effective Dates (Subsidiaries of United States Steel Corporation)*

PITTSBURGH

Date Announced	Date Effective	For Shipments to	Structural Shapes	Plates	Soft Steel Bars	Hot Rolled Sheets	Hot Rolled Annealed Sheets 24 Ga.	Galvanized Sheets 24 Ga.	Hot Rolled Strip	Tin Plate	O. H. Steel Billets	St'd Steel Rails
			100#	100#	100#	100#	100#	100#	100#	Base Box 100#	Gross Tons	Gross Tons
12- 1-38	12- 1-38	3-31-39	$2.10	$2.10	$2.25	$2.15	Not Sold as Such After May 18, 1938	$3.50	$2.15		$34.00	
12- 1-38	12- 1-38	6-30-39										$40.00
11-10-38	1- 1-39	3-31-39								$5.00		
9-20-38	9-20-38	12-31-38	2.10	2.10	2.25	2.15		3.50	2.15		34.00	40.00
6-24-38	6-24-38	9-30-38	2.10	2.10	2.25	2.15		3.50	2.15		34.00	
5-18-38	5-18-38	9-30-38	2.25	2.25	2.45	2.30		3.80	2.30		37.00	42.50
2-18-38	2-18-38	6-30-38	2.25	2.25	2.45	10 Ga. Base 2.40	$3.15	3.80	2.40		37.00	42.50
12- 3-37	1- 1-38	9-30-38								5.35		
10-15-37	10-15-37	3-31-38	2.25	2.25	2.45	2.40	3.15	3.80	2.40		37.00	42.50
8- 5-37	8- 5-37	12-31-37	2.25	2.25	2.45	2.40	3.15	3.80	2.40		37.00	42.50
7-20-37	7-20-37	12-31-37	2.25	2.25	2.45				2.40		37.00	42.50
7- 1-37	7- 1-37					2.40	3.15	3.80				
5-12-37	5-12-37	9-30-37	2.25	2.25	2.45	2.40	3.15	3.80	2.40		37.00	42.50
4- 6-37	4- 6-37	9-30-37								5.35		
3- 5-37	3- 5-37											42.50
3- 5-37	3- 5-37	6-30-37	2.25	2.25	2.45	2.40	3.15	3.80	2.40		37.00	
11-24-36	12- 1-36	3-31-37	2.05	2.05	2.20				2.15		34.00	
11-24-36	1- 1-37	3-31-37				2.15	2.80	3.40				
11-18-36	1- 1-37	9-30-37								4.85		
12- 1-36	12- 1-36	3-31-37										39.00
10- 1-36	10- 1-36	12-31-36				1.95	2.60	3.20				
9- 5-36	9- 5-36	12-31-36	1.90	1.90	2.05	1.95	2.60		1.95		32.00	
5-26-36	5-26-36	9-30-36	1.90	1.90	1.95	1.95	2.50	3.20	1.95		30.00	
5-23-36	5-23-36	9-30-36	1.90	1.90								
3-17-36	4- 1-36	6-30-36			1.85				1.85		28.00	
3-12-36	3-12-36	6-30-36	1.80	1.80							29.00	
1-14-36	1- 1-36	3-31-36			1.85				1.85			
11-27-35	12- 2-35	3-31-36	1.80	1.80								
Prior Price Prevailing			1.80	1.80	1.85	1.85	2.40	3.10	1.85	5.25	29.00	36.37½

CHICAGO

Date Announced	Date Effective	For Shipments to	Structural Shapes	Plates	Soft Steel Bars	Hot Rolled Sheets	Hot Rolled Annealed Sheets 24 Ga.	Galvanized Sheets 24 Ga.	Hot Rolled Strip	Tin Plate	O. H. Steel Billets	St'd Steel Rails
12- 1-38	12- 1-38	3-31-39	2.10	2.10	2.25	2.15	Not Sold as Such After May 18, 1938	3.50	2.15	5.00	34.00	40.00
12- 1-38	12- 1-38	6-30-39										40.00
11-10-38	1- 1-39	9-30-39								5.00		
	9-24-38	12-31-38	2.10									
	9-23-38					2.15						
9-20-38	9-20-38	12-31-38						3.50	2.15	5.35	34.00	40.00
	8-31-38		2.10	2.10								
6-24-38	6-24-38	9-30-38	2.10	2.10		2.15		3.50	2.15	5.35	34.00	
5-18-38	5-18-38	9-30-38	2.30	2.30		2.40			2.40		37.00	42.50
2-18-38	2-18-38	6-30-38	2.30	2.30		10 Ga. Base 2.50	3.25	3.90			37.00	42.50
12- 3-37	1- 1-38	9-30-38								5.45		
10-15 37	10-15-37	3-31-38	2.30	2.30		2.50	3.25	3.90			37.00	42.50
8- 5-37	8- 5-37	12-31-37	2.30	2.30		2.50	3.25	3.90	2.50		37.00	42.50
7-20-37	7- 1-37		2.30	2.30		2.50	3.25	3.90	2.50	5.45	37.00	42.50
5-12-37	5-12-37	9-30-37	2.30	2.30		2.50	3.25	3.90	2.50		37.00	42.50
4- 6-37	4- 6-37	9-30-37								5.45		
	3- 5-37		2.30	2.30								
3- 5-37	3- 5-37	6-30-37				2.50	3.25	3.90			37.00	42.50
	1- 1-37		2.10	2.10								
12- 1-36	12- 1-36	3-31-37										39.00
11-24-36	1- 1-37	9-30-37	2.10	2.10		2.25	2.90	3.50	2.25			
11-18-36	1- 1-37	9-30-37								4.95		
10- 1-36	10- 1-36	12-31-36				2.05	2.70	3.30				
9- 5-36	9- 5-36	12-31-36	1.95	1.95	2.10	2.05	2.70		2.05			
5-26-36	5-26-36	9-30-36	1.95	1.95	2.00	2.05	2.60		2.05			
5-23-36	5-23-36	9-30-36	1.95	1.95								
	12-31-35				1.90				1.95		29.00	
	12- 2-35										29.00	
11-26-35	1- 1-36	9-30-36								5.35		
Prior Price Prevailing			1.85	1.85	1.90	1.95	2.50	3.20	1.95	5.35	27.00	36.37½

(*39*) See the comments in *The Iron Age*, Nov. 26, 1936, p. 77; Dec. 3, 1936, pp. 62, 105; Dec. 10, 1936, pp. 93, 96; Dec. 17, 1936, p. 85; and Jan. 7, 1937, pp. 66, 99, 183. The gist of these statements is that bookings in December, 1936 were probably the largest monthly bookings in peace-time steel history, and that the major part of the orders were placed as protection against announced January 1, 1937 price advances.

(*40*) See Table 1. Peak bookings in 1929 totalled 1,590,793 tons in March. The December, 1936 total was exceeded in only three months of United States Steel Corporation history: In November, 1912 with 2,062,939 tons, in March, 1916 with 2,064,472 tons, and in November, 1916 with 2,357,161 tons.

(*41*) See notes 20, 23, 27 and 29.

(*42*) Delivery promises of the Carnegie-Illinois Steel Corporation on most sheet mill products in December, 1936 averaged about 3½ to 4½ months. That such conditions were general in the industry may be seen from statements in *The Iron Age*, Dec. 3, 1936, p. 97; Dec. 10, 1936, p. 93; Dec. 17, 1936, p. 89; and Dec. 31, 1936, p. 67, where it is pointed out that backlogs on some products extended completely through the first quarter of 1937.

(*43*) See the remarks verifying the statement in *The Iron Age*, Dec. 3, 1936, p. 62; Dec. 10, 1936, p. 96; Dec. 24, 1936, p. 47; and Jan. 7, 1937, pp. 66, 99, and 183, and other sources cited in note 39. See also notes 22, 40, 57 and 61.

(*44*) Steel prices are ordinarily changed only at the beginning of each quarter, with the announcements of changes coming usually in the last month of the preceding quarter. See also the comments in *The Iron Age*, Feb. 25, 1937, p. 91.

(*45*) See Table 16 in note 27, note 21 and the statement in *The Iron Age*, Feb. 25, 1937, p. 114.

(*46*) See Table 1, and Appendix Table 19, in note 38. See also the remarks in *The Iron Age*, March 11, 1937, pp. 111, 114; April 1, 1937, p. 95, and April 15, 1937, p. 89.

(*47*) See notes 20 and 23, and *Survey of Current Business, 1938 Supplement*, p. 141.

(*48*) See note 27. See also *The Iron Age*, Mar. 11, 1937, p. 133; Apr. 1, 1937, p. 118; and May 6, 1937, p. 116.

(*49*) The delivery situation is summarized in statements in *The Iron Age*, Mar. 25, 1937, p. 85; April 15, 1937, p. 89; and in *Steel*, Mar. 15, 1937, p. 103; Mar. 22, 1937, p. 75; and Mar. 29, 1937, p. 83.

(*50*) See note 17. If Veterans' Bonus payments in June 1936 are taken into account, consumers' real income in March, 1937 was almost seven percent below the level of the previous June (on a seasonally adjusted basis).

(*51*) Although there are no monthly figures on business outlays for capital equipment, rough interpolation of column (1) Table 2, note 2, by the series in Table 16, note 27, indicates that business capital equipment expenditures in the period March, 1936 to March, 1937 were roughly half again as great as in 1935 and approximately equal to 1929 figure.

(*52*) The U. S. Bureau of Labor Statistics estimated that in December 1936 there were 258 industrial disputes in progress, in March 1937, 760. Man days idle due to labor disputes for the same period increased from 2.1 million to 3.3 million. See: *Survey of Current Business, 1938 Supplement*, p. 39.

(*53*) See: *Survey of Current Business, 1938 Supplement*, p. 85.

(*54*) For example, see the comments in *The Annalist*, March 26, 1937, p. 482; April 9, 1937, p. 554; April 16, 1937, pp. 604, 608; April 23, 1937, p. 650; April 30, 1937, pp. 681, 682; May 7, 1937, p. 722. The fall of security and basic commodity prices which began in February to April, 1937, led to the belief that the speculative part of the boom was coming to an end, and that prices of securities and basic commodities were going to adjust to a more stable position.

(*55*) See: *Survey of Current Business, 1938 Supplement*, pp. 56, 75 and 77.

(*56*) See Table 1. Total domestic bookings of United States Steel Corporation in the six consecutive peak months of 1929 amounted to 8,215,225 tons.

(*57*) No data are available showing changes in inventories of *steel* in the hands of buyers (producers of products made from steel). That inventories were becoming excessive, however, is borne out by the following statements:

After stating that steel consumers were building up inventories of finished products and work-in-process beyond the level required by current sales *The Iron Age* in its April 22, 1937 issue, page 90, commented:

"This leads steel sellers to the conclusion that we are approaching a time when ultimate consumers must be given time to digest a surplus."

Throughout the spring and summer similar statements pointing to the growth of excessive inventories appeared in increasing volume and emphasis. See *The Iron Age*, May 6, 1937, p. 103 (Some stove manufacturers have enough steel to meet all of their remaining 1937 requirements.); May 20, 1937, p. 93 (Steel jobbers are trying to reduce their heavy stocks.) and p. 84 (Large steel consumers are well taken care of owing to large stocks on hand and heavy orders placed but not yet received.); June 3, 1937, pp. 97, 98; June 10, 1937, p. 103; July 22, 1937, p. 109; Aug. 12, 1937, p. 107; Aug. 19, 1937, p. 91; Aug. 26, 1937, p. 87; Sept. 2, 1937, p. 88 (". . . fresh business is undoubtedly being affected by the presence of greater than expected inventories at consumers' plants."); Sept. 9, 1937, p. 107; Sept. 16, 1937, p. 105 (Steel consumers are liquidating their stocks before placing replenishment orders.); Sept. 23, 1937, p. 101 (Inventories almost universally are excessive; with sales of products made from steel slowing down, liquidation of heavy steel inventories is proceeding slowly.).

Table 20 below shows the value of inventories of materials, supplies, work-in-process, and other inventories excluding finished products in the hands of various steel consumers on January 1 and December 31, 1937 as reported by the U. S. Bureau of Census (See: U. S. Department of Commerce, Bureau of the Census: *Census of Manufactures, 1937*, preliminary release dated April 15, 1939, with title "Inventories, January 1 and December 31, 1937").

Although inventories of steel are not reported separately, it is doubtful if they varied significantly from the broad picture shown by the figures below.

TABLE 20.—*Value of Inventories of Materials, Work in Process, Etc. in the Hands of Various Steel Consumers January 1, 1937 and December 31, 1937*

Industry	Value of Inventories of Materials, Work in Process, etc. ($000)		
	Jan. 1, 1937	Dec. 31, 1937	Per cent Increase
Agricultural implements (including tractors)	$101,472	$112,388	11%
Aircraft and parts	24,968	43,348	74
Boiler-shop products	17,958	21,941	22
Bolts, nuts, washers, and rivets made in plants not operated in connection with rolling mills	9,080	9,951	10
Cars, electric and steam railroad not built in railroad repair shops	26,930	37,163	38
Cash registers, adding and calculating machines, and other business machines except typewriters	21,400	27,307	28
Cranes, and dredging, excavating and road building machinery	17,770	24,895	40
Cutlery (not including silver and plated cutlery) and edge tools	8,872	11,455	29
Electrical machinery, apparatus, and supplies	187,236	253,593	35
Engines, turbines, water wheels, and windmills	31,839	40,260	26
Locomotives, railroad, mining, and industrial not made in railroad repair shops	11,947	21,053	76
Machinery, not elsewhere classified	110,919	135,485	22
Machine-shop products	62,135	71,817	16
Machine tools	34,673	44,551	28
Motor vehicles not including motorcycles	173,139	214,808	24
Motor-vehicle bodies and motor-vehicle parts	125,804	128,211	2
Refrigerators and refrigerating and ice-making apparatus	26,020	32,765	26
Ship and boat building, steel and wooden, including repair work	24,962	31,091	25
Stamped and pressed metal products; enameling, japanning, and lacquering	27,019	31,345	16
Steel barrels, kegs, and drums	6,178	6,814	10
Structural and ornamental metal work, made in plants not operated in connection with rolling mills	31,749	38,583	22
Textile machinery and parts	13,758	16,251	18
Tin cans and other tinware, not elsewhere classified	49,593	76,963	55
Tools, not including edge tools, machine tools, files, or saws	12,764	15,488	21
Washing machines, wringers, driers and ironing machines for household use	6,115	6,698	10
Wire drawn from purchased rods	15,015	16,936	13
Wirework not elsewhere classified	15,640	17,460	12
Foundry products (gray-iron and malleable iron)	21,577	22,946	6
Forgings iron and steel, made in plants not operated in connection with steel works or rolling mills	12,304	13,522	10
Hardware not elsewhere classified	27,161	30,740	13
Heating and cooking apparatus except electric	51,096	61,484	20
Machine-tool accessories and machinists' precision tools	14,163	16,235	15
Pumps (hand and power), pumping equipment and air compressors	21,508	27,567	28

(*58*) See Table 1. In the last week of April steel producers announced the continuation of second quarter prices through the third quarter. *The Iron Age*, April 29, 1937, p. 99, made the following comment:

"The principal incentive for forward buying having been removed by the announcements of a continuation of present steel prices through the third quarter, an easier situation prevails in the steel market."

See also: *The Iron Age*, April 22, 1937, p. 94; April 29, 1937, pp. 103, 105, 106, 108; May 6, 1937, p. 116; May 13, 1937, p. 140; July 15, 1937, p. 95 (No price advances expected for fourth quarter.).

As early as the middle of July, third quarter prices for most steel products were reaffirmed for the fourth quarter. (See *The Iron Age*, July 22, 1937, p. 99). This completely removed the price incentive for forward buying.

(*59*) By the end of September delivery promises of the Carnegie-Illinois Steel Corporation, for example, had dropped from the March, 1937 peak of six to seven months for most sheet mill products to two to four weeks, which is normal when there are no mill backlogs.

(*60*) The Standard Statistics Co. Inc., index of prices of 348 industrial stocks stood at 126.2 (1926=100) in September 1937, and at 95.2 in December 1937. See *The Survey of Current Business, 1938 Supplement*, p. 77.

(*61*) There are no series available showing separately (1) inventories of steel in the hands of consumers, and (2) inventories of finished and semi-finished products made from steel in the hands of producers. However, this limitation is not serious; excessive inventories of finished and semi-finished products made from steel, as effectively reduce the demand for steel as excessive inventories (in the hands of steel consumers) of steel itself.

Table 21 below shows the year end value of inventories of various steel consuming industries. These inventories include raw materials (including steel), fuel, supplies, work-in-process, finished products, etc. These figures are the revised estimates of Dun and Bradstreet, Inc. based on their Surveys of Inventory Trends. The mid-year estimates for 1939 are from *Dun's Review*, Sept. 1939, pp. 8, 10 and 12.

TABLE 21.—*Inventories 1935–1938 for Selected Manufacturing, Wholesaling and Retailing Lines*

Industry	1935 Year End Inventories ($000)	1936 Year End Inventories ($000)	1937 Year End Inventories ($000)	1938 Year End Inventories ($000)	July 1, 1939 Inventories ($000)
Manufacturing:					
Iron and Steel Products	$89,093	$111,366	$131,412	$109,072	$116,000
Hardware	203,838	238,491	290,959	261,863	266,000
Foundries	29,788	34,852	39,034	34,584	------
Electrical Apparatus and Appliances	329,773	395,728	557,976	423,504	418,000
Machine Shop Products	156,643	186,405	234,870	210,678	------
Agricultural Machinery	143,689	172,427	227,604	185,497	172,000
Automobiles	310,559	366,460	436,087	326,193	240,000
Automobile Accessories and Parts	197,704	257,015	341,830	266,969	229,000
Wholesaling:					
Hardware	120,328	139,581	140,977	134,210	139,000
Automobile Equipment	99,730	114,690	125,012	122,012	127,000
Plumbing and Heating Supplies	57,019	62,151	67,745	63,816	67,000
Machinery and Equipment	68,692	79,683	94,823	90,556	92,000
Electrical Goods and Appliances	59,659	80,540	99,870	77,899	86,000
Retailing:					
Farm Implements	34,080	46,272	53,676	53,569	52,000
Radio, Electric and Gas Household Appliances	73,407	73,935	92,419	83,085	89,000
Hardware	196,562	202,022	218,184	214,475	221,000
Hardware and Farm Implements	44,937	49,913	55,902	55,119	56,000
Motor Vehicle Dealers	399,685	398,267	561,557	463,846	535,000
Automobile Accessories (Independents)	29,843	32,299	36,498	37,702	40,000
Automobile Accessories (Chains)	29,843	33,461	37,811	37,055	46,000

See also note 57 and the source quoted there, and *The Iron Age*, May 11, 1939, pp. 57, 58, 58–A and 58–B for other inventory figures. The inventory situation as it affected the demand for steel is also discussed in *The Iron Age*, Oct. 7, 1937, p. 97 and p. 105 (One fact stands out prominently—stocks in the hands of many consumers and jobbers are large enough to last for many weeks at the current rate of consumption.); Oct. 28, 1937, p. 91; Nov. 11, 1937, p. 113 (Auto companies have a large carryover of steel not used in the production of 1937 models.); and p. 119 (Consumption of stocks going on slowly.); Jan. 20, 1938, p. 93; Feb. 24, 1938, p. 56 (Auto producers still have large inventories of steel.).

(62) See the comments in *The Iron Age*, Jan. 27, 1938, p. 75; Feb. 3, 1938, p. 91; Feb. 10, 1938, p. 97; Feb. 17, 1938, pp. 98, 99; Feb. 24, 1938, p. 85; May 5, 1938, pp. 86–87; May 12, 1938, p. 106; May 19, 1938, p. 68; May 26, 1938, p. 95; June 2, 1938, p. 92; June 23, 1938, pp. 72–75; and Jan. 5, 1939, pp. 73, 106, 110.

(63) See: *The Iron Age*, Feb. 17, 1938, p. 54.

(64) See: *The Iron Age*, Feb. 17, 1938, pp. 54, 98–99; and Feb. 24, 1936, p. 85.

(65) See: *The Iron Age*, Feb. 24, 1938, p. 85.

(66) See: *The Iron Age*, May 5, 1938, pp. 86–87; May 12, 1938, p. 106; May 19, 1938, p. 68; June 2, 1938, p. 92.

(67) See: *The Iron Age*, May 26, 1938, pp. 88, 95.

(68) See: *The Iron Age*, June 16, 1938, p. 81, and June 23, 1938, pp. 72, 75.

(69) See the statements in *The Iron Age*, Mar. 10, 1938, p. 95; June 16, 1938, p. 81; Jan. 5, 1939, pp. 73, 106; July 21, 1938, p. 70. See also note 61.

(70) See especially the article by C. E. Wright, "Basing Point Changes May Alter Industrial Map of the United States," in *The Iron Age*, July 7, 1938, pp. 84–D, *et seq.*, and in the same journal, June 30, 1938, pp. 60–63. See also: July 7, 1938, p. 86; July 14, 1938, p. 80; July 21, 1938, p. 70.

(71) See notes 24 and 29.

(72) See: *The Iron Age*, Aug. 11, 1938, pp. 42, 64.

(73) See: *The Iron Age*, Oct. 13, 1938, pp. 306, 308–309; Oct. 20, 1938, p. 66; Jan. 5, 1939, pp. 110, 176.

(74) See Table 1, and the comment in *The Iron Age*, Oct. 20, 1938, p. 66, and Jan. 5, 1939, pp. 110, 176.

(75) See Tables 5, 10, 14 and 16.

(76) See Table 1, and the comments in *The Iron Age*, Jan. 5, 1939, p. 221; Jan. 26, 1939, pp. 74 and 76; Feb. 2, 1939, p. 96; Feb. 23, 1939, p. 76; Mar. 2, 1939, pp. 70 and 84; Mar. 23, 1939, p. 82; April 13, 1939, p. 94.

(77) See, for example, the statements in *The Iron Age*, Feb. 23, 1939, p. 76; Mar. 2, 1939, p. 70; and Mar. 30, 1939, pp. 46–48.

(78) See *The Iron Age*, April 13, 1939, p. 94; April 27, 1939, p. 88; and May 4, 1939, p. 98.

(79) See the discussion in *The Iron Age*, May 11, 1939, pp. 96 and 98; May 18, 1939, pp. 124 and 126–127; May 25, 1939, pp. 61–62; and June 15, 1939, pp. 69 *et seq.*

(80) See Table 1, and *The Iron Age*, issues from June to August, 1939.

Exhibit No. 1413

AN ANALYSIS OF THE DEMAND FOR STEEL IN THE AUTOMOBILE INDUSTRY

This is an analysis prepared by the Special Economic Research Section of United States Steel Corporation, composed of Messrs. Edward T. Dickinson, Jr., Ernest M. Doblin, H. Gregg Lewis, Jacob L. Mosak, Mandal R. Segal, Dwight B. Yntema and Miss Marion W. Worthing. The work of this group was under the supervision of Theodore O. Yntema, Professor of Statistics, University of Chicago. This analysis was written by Jacob L. Mosak and has had the benefit of suggestions from other members of the staff. It is issued by United States Steel Corporation

November 1, 1939.

CONTENTS

I. Purpose

The purpose of this study is to review the factors which determine the demand for steel as a raw material in the automobile industry, and to appraise particularly the relative significance of the price of steel as one of these factors.

II. Summary of the Findings

The quantity of steel consumed as a raw material by the automobile manufacturing industry depends directly upon (1) the number of cars produced; (2) the quantity of steel used per car; and (3) the production of replacement parts and related equipment. The price of automotive steel can affect the quantity sold only by influencing one or more of these three factors.

The demand for automobiles has recently been the subject of an exhaustive study by C. F. Roos and Victor von Szeliski.[1] They found that the number of new passenger cars sold in any year was dependent on (1) national income; (2) the number of cars in operation; (3) the age distribution of cars in operation; (4) the scrapping rate; (5) the price; and (6) other factors including used car allowances, financing terms, operating costs and dealers' used car stocks. After making proper allowance for the influence of national income, number of cars in operation, age distribution and scrapping rate, they concluded that the elasticity of demand for new passenger cars was approximately 1.5; or in other words, that a 1% reduction in the price of cars would cause a 1.5% increase in the number of cars sold.

A change in the price of steel could affect the number of automobiles sold only if it were passed on to the ultimate consumer as a reduction in the price of cars. The cost of steel in a car is, however, only approximately 13% of the f. o. b. price, or approximately 10% of the delivered price of the car. A reduction of 10% in the price of automotive steel would therefore permit a reduction of only 1% in the delivered price of the car if it were passed on entirely to the consumer. Since this 1% reduction in automobile prices would give rise to only a 1.5% increase in the number of cars sold, it follows that a 10% reduction in the price of steel would give rise to an increased consumption of steel of but 1.5% through its effect on the number of cars sold. Thus changes in the price of steel are far from effective in raising the consumption of steel through increasing the volume of car sales.

From the evidence available, the price of steel appears to have an even less significant effect on the quantity of steel used per car. The increased use of steel per car over the past fifteen years is mainly attributable to the increased popularity of enclosed models and heavier cars, and intense competition among motor companies in the improvement of their product. The conclusion that the price of steel is a minor influence in the quantity of steel consumed per car is supported by the absence of a relationship between the weight of passenger cars and the price of steel after the series have been adjusted for secular trends.

Replacement parts and accessories have a value only about one-seventh as great as new cars produced. It seems reasonable to conclude that the elasticity of demand for these products is not greatly different from the elasticity of demand for new cars. But even if parts and accessories had an appreciably higher elasticity of demand, because of their relatively small value they could not have much effect on the elasticity of demand for all automotive steel.

The total effect of a reduction in price upon the consumption of steel by the automobile industry, through increase in the volume of car production, increase in the use of steel per car, and increase in the production of replacement parts and accessories, is therefore relatively slight. Combining these elements, the elasticity of demand for automobile steel is probably not in excess of .2 or .3. In other words, a 10% reduction in the price of such steel could not increase the consumption of steel in the motor vehicle industry by more than 2 or 3%.

The price of steel is therefore a minor factor in determining the quantity of steel consumed as a raw material in the automobile industry.

III. The Automobile Industry

A brief review of the growth of the automobile industry to its present-day position is basic to an understanding of the nature of the demand for automobiles and of the derived demand for steel. From a stage of infancy in 1900 when production amounted to only 4,000 vehicles, the manufacture of automobiles rapidly matured into an industry of first importance with a production of 4 million vehicles in 1923. Between 1923 and 1929 production averaged about 4.4 million vehicles annually, of which more than 85% were passenger cars. During the same period the dollar volume of production averaged nearly 3 billions annually, of which about 2.5 billions represented passenger car production. In the recent peak year, 1937, production stood at 5 million motor vehicles having a wholesale value of 2,970 million dollars. Of this amount about 80% represented pas-

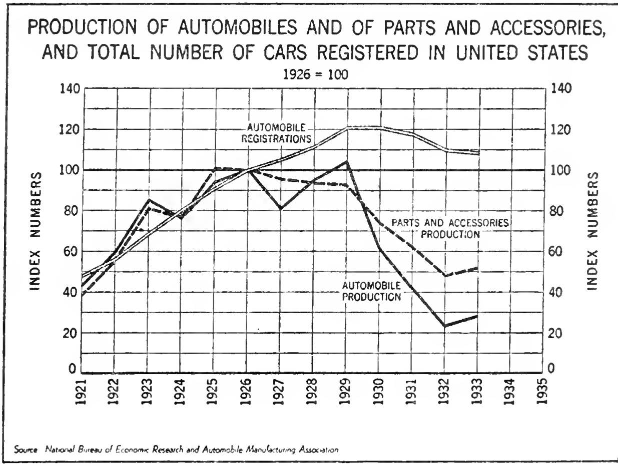
[1] C. F. Roos and Victor von Szeliski "Factors Governing Changes in Domestic Automobile Demand", *The Dynamics of Automobile Demand*, General Motors Corporation, N. Y., 1939.

senger cars.[2] In the census year 1935 the industry gave employment to 164,000 people and had a total wage bill of 217 million dollars.[3]

Complementary to the motor vehicle industry is the important motor vehicle bodies and parts industry. In 1935 this industry employed 60% more wage earners and had a 50% larger wage bill than did the motor vehicle manufacturing industry proper. If the two industries are added together the total number of employees in the automotive industry in 1935 was 425,000 and the total wage bill was 545 million dollars.[4]

However the dollar volume of output in the two industries cannot be added together, since that would involve duplication. It has been estimated that between 75 and 80% of the production of motor bodies and parts ordinarily represents original equipment entering into the production of new cars. If this portion of output is subtracted from the total it appears that the dollar output of

CHART 1



replacement parts at producers' prices averaged only 287 million dollars in the census years, 1923, 1925, 1927 and 1929. If in addition there are added certain other accessories such as skid chains, stamped automotive parts and storage batteries, the total production at producers' prices of replacement parts and accessories averaged 407 million dollars.[5]

It has been estimated that in 1938 the total employment offered directly and indirectly in motor vehicle bodies and parts, tires and petroleum refining plants, sales and servicing, road building, truck and bus driving, in the raw material supply industries and in automobile insurance and finance companies was well over 6 million persons.[6] This is about 14% of the total gainfully employed in the United States. It has been further estimated that approximately 14 billion dollars of new investment went into the furnishing of motor transport directly and indirectly in the period 1923 to 1929.[7] This is about equal to the amount that was

[2] *Statistical Abstract of the United States*, 1938, page 370.
[3] United States Department of Commerce, *Census of Manufactures*, 1935, page 29.
[4] *Ibid.*
[5] S. Kuznets, *Commodity Flow and Capital Formation*, National Bureau of Economic Research, New York, 1938, pages 66 and 88.
[6] *Automobile Facts and Figures*, Automobile Manufacturers Association, 1938, page 47.
[7] Wendell D. Hance, "*The Role of the Automobile Industry*", paper presented before the American Economic Association, December 28, 1938, typescript, pages 3–5. See also, *Automobile Facts and Figures*, Automobile Manufacturers Association, 1938, page 51.

invested during the same period in railroads, electric power and telephone companies combined.[8]

Like other durable goods industries, however, the automotive industry has not experienced uninterrupted growth but has been subject to great fluctuations in production and employment. This is shown by Chart 1 and by the figures on production, employment, and payrolls for selected years given in Table 1:

As is to be expected, the fluctuations in the consumers' stocks of automobiles, as evidenced by automobile registrations, are much smaller in amplitude than the fluctuations in production (Chart 1). This follows directly from the fact that the automobile is a durable good. Once bought, it yields services over a period of five to fifteen years, and no further purchases are necessary, except for replacement.

TABLE 1.—*Production, Employment and Payrolls in the Motor Vehicle Industry for Selected Years*

Year	Production (millions of cars)	Bureau of Labor Statistics Index of Employment, 1923–5=100 (monthly average)	Bureau of Labor Statistics Index of Payrolls, 1923–5=100 (monthly average)
1921	1.7	52.9	48.7
1929	5.6	111.3	111.6
1932	1.4	60.5	38.8
1937	5.0	128.3	124.1

Sources: *Statistical Abstract of the United States*, 1938, p. 370. *Survey of Current Business*, 1938 Supplement, pp. 32 and 41, and November, 1938, pp. 14, 18.

Replacement purchases, however, can be postponed, since the old car can almost always be made to serve another year if economic conditions are adverse. This difference in fluctuation is clearly seen by comparing the figures in Table 2 on total number of cars registered and on gasoline consumption with those shown above on production and employment in Table 1.

TABLE 2.—*Total Number of Cars Registered and Gasoline Consumption for Selected Years*

Year	Total Number of Cars Registered (millions)	Gasoline Consumption (million barrels)
1921	10.5	9.0
1929	26.5	31.0
1932	24.1	31.2
1937	29.7	13.2

Sources: Automobile Manufacturers Association, *Automobile Facts and Figures*, 1938, pp. 15 and 16, and 1929, p. 14; *Survey of Current Business*, 1938 Supplement, p. 121.

Since most of the production of motor bodies and parts represents original equipment entering into the production of new cars, it is natural that the two series should have similar fluctuations, as shown in Table 3.

TABLE 3.—*Value of product in the automobile industry for selected years*

[Millions of dollars]

Year	Motor Vehicles	Bodies and Parts
1929	$3,710	$1,551
1931	1,568	945
1933	1,097	756
1935	2,391	1,551

Source: *Census of Manufactures*, 1935, pp. 1150 and 1156.

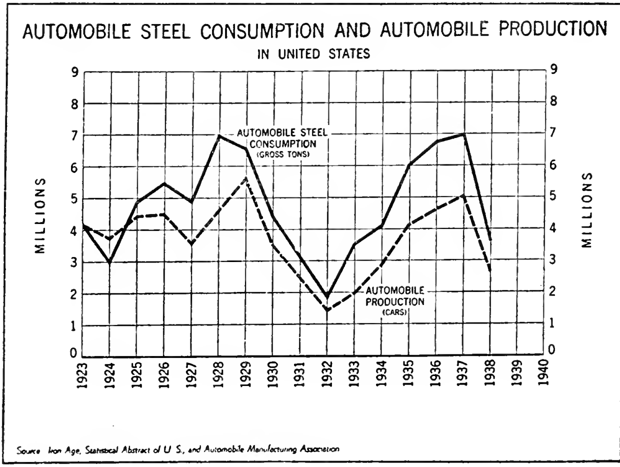
[8] *Charts and Tables for Use in Hearings on Savings and Investment before the Temporary National Economic Committee May 16 to 26, 1939, Investment Banking Section, Securities Exchange Commission.* Supplementary Table I-a, "Plant and Equipment Expenditures", introduced by Lauchlin Currie, May 13, 1939.

It appears, however, that even if that portion of the production of all accessories and parts which is used for replacement purposes is segregated, the fluctuations in this segregated series still conform to the changes in automobile production rather than to those in the total number of cars registered.[9] This indicates that the factors affecting the demand for replacement parts are roughly the same as those affecting the demand for automobiles.

IV. Steel Consumption

The automotive industry has been the largest single consumer of steel for five of the last six years, taking between one-quarter and one-sixth of the total finished steel output. For the period 1923–1938 it consumed on the average almost 5 million tons of steel per year.[10] About 125 different kinds of steel are used in the modern automobile. Chief among these are sheets. The automobile industry in 1937 took about 45% of total production of sheets, and in addition it used

Chart 2



about 55% of the total production of strip and 45% of the total production of bars.[11]

Large quantities of steel are bought annually for the production of automobile accessories and parts for replacement. As has already been noted, the annual production of these parts amounts to about one-seventh of the value of passenger cars produced. In addition, steel is bought for the production of tools and dies, for repairs and maintenance and for capital investment in plant and equipment of the automobile industry.[12]

The latest available estimates of automotive steel consumption show that the steel shipments to the automotive industry have fluctuated in fairly close conformity with automobile production. From Chart 2 it appears that in every year 1923–1938, except in 1929, the two series moved in the same direction, although, it should be noted, the changes were not proportional to each other.[13]

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[9] See Table 8 in the Appendix.
[10] See Table 9 in the Appendix.
[11] *Automobile Facts and Figures*, 1938, page 47.
[12] The automobile industry is, of course, also responsible for a great deal of steel consumption in the building of highways, bridges, filling stations, and plant and equipment in the petroleum and rubber tires industries. This indirect steel consumption is not dealt with here.
[13] See Table 9 in the Appendix. The available data on steel consumption by the automobile industry are not entirely satisfactory, since the coverage and classification of steel purchases in the magazine *Steel* differ from those in *Iron Age*, and the coverage and classification differ from year to year in the same magazine. However, for the purposes for which the data are used here these limitations are not prohibitive.

An important feature of automotive steel consumption has been the ever continuous tendency to increase the use of steel in automobile construction.[14] The increased use of steel has resulted from the larger size of modern cars, the adoption of all-steel tops and bodies by automobile producers and the trend toward heavier cars and enclosed models. From 1925 to 1930 the percentage of open model cars decreased from 30% to 0.5%.[15] In recent years, however, this tendency has been somewhat offset by the use of greater glass area and of plastics. Experiments are now being conducted to determine the practicability of using plastics even for automobile bodies. If successful, this may have an appreciable effect on automotive steel consumption.

V. The Demand for Automobiles

The authoritative study of the nature of the demand for automobiles made by Messrs. Roos and von Szeliski [16] relates to retail sales of passenger cars within the United States for the years 1919–38, and does not include commercial cars and trucks, nor exports of any vehicles. This, however, is not a serious limitation, for, as already noted, passenger-car production represents about 80% of total motor vehicle production, and domestic sales of passenger cars constitute about 75% of total sales.[17] The following analysis draws heavily upon this study.

A. Major factors affecting the year to year changes in sales of new automobiles

As with all durable goods, the demand for new automobiles is derived from the demand for services which they yield. Since the automobile yields transportation services for a period from five to fifteen years, the demand for these services may be satisfied by running the old cars another year or by buying used cars instead of new cars. Thus the consumption of automobile services is disassociated from the purchases of new cars, and, as is to be expected, the former is far more stable than the latter. This is illustrated in Chart 1 and in Table 8 in the Appendix, in which automobile production is contrasted with registrations. The number of cars in use held up relatively well even in the trough of the depression, while the sale of new cars suffered a great decline.

(1) *Consumer Income.*—The level of consumer income is, of course, a major factor in determining the number of new car sales. When the level of income is high, sales will be high; conversely, when national income is low, car sales will be low. This is illustrated in Table 4 and in Chart 3, which relate new car sales to consumer disposable income (Table 4, Columns 2 and 3, and Chart 3).

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[14] See Table 7.

[15] *Steel Facts*, American Iron and Steel Institute, December, 1936, No. 16, page 3.

[16] *Op.. cit. supra,*

[17] S L. Horner, "Statement of the Problem," *The Dynamics of Automobile Demand*, page 7.

TABLE 4.—*Retail Passenger Car Sales, Disposable Income, Minimum Cost of Living and Supernumerary Income, 1919–1938*

Year (1)	Retail Passenger Car Sales [1] (thousand units) (2)	Disposable Income [2] (billion dollars) (3)	Necessitous Living Costs [3] (billion dollars) (4)	Supernumerary Income [4] (billion dollars) (5)
1919	1,591	$61.38	$21.92	$39.46
1920	1,657	66.29	25.44	40.85
1921	1,471	53.60	22.22	31.38
1922	2,088	56.45	21.38	35.07
1923	3,351	64.98	22.30	42.68
1924	3,172	66.02	22.98	43.04
1925	3,252	69.46	23.86	45.60
1926	3,495	72.94	24.18	48.76
1927	2,705	72.53	24.02	48.51
1928	3,396	74.92	24.08	50.84
1929	4,036	78.50	24.30	54.20
1930	2,652	71.21	23.68	47.53
1931	1,903	60.29	21.52	38.77
1932	1,096	46.67	19.42	27.25
1933	1,526	45.23	18.82	26.41
1934	1,928	52.38	20.10	32.28
1935	[5] 2,531	55.55	20.90	34.65
1936	[5] 3,369	63.06	21.66	41.40
1937	[5] 3,749	68.97	22.76	46.21
1938	[5] 1,850	64.20	22.66	41.54

Source: Data used by Roos and von Szeliski in *The Dynamics of Automobile Demand.*

[1] For 1919–1925 the data represent factory production, less exports and foreign assemblies, less assumed changes in dealers' stocks; for 1926–1929 the data are estimated by General Motors from retail sales of General Motors passenger cars and new car registrations of other passenger cars; for 1930–1938 the data are estimates of the Automobile Manufacturers Association.

[2] Figures for 1929–1938 are Department of Commerce income payments series, plus entrepreneurial savings, less Federal income, gift, estate and inheritance taxes; figures for 1919–1928 are a backward extension of 1929–1938 figures, on basis of data provided in Kuznets' *National Income and Capital Formation, 1919–1935*, less Federal and direct taxes.

[3] Estimated at $200 per capita for 1923 and varying with the National Industrial Conference Board Index of the Cost of Living for other years.

[4] Equals column (3) minus column (4).

[5] Model year (12 months) ending in October.

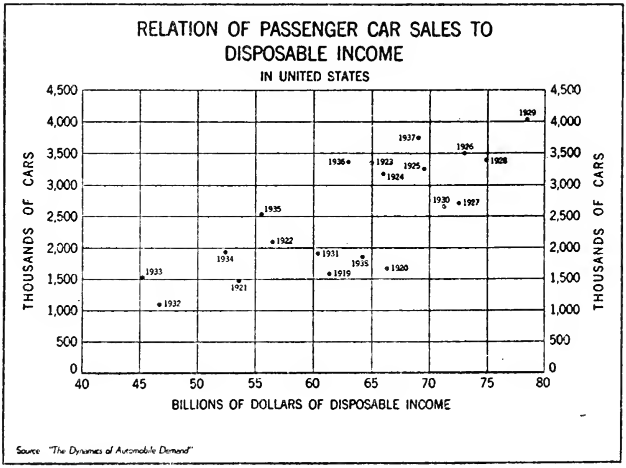
A somewhat more refined analysis is possible if consumer income is adjusted by deducting necessitous expenditure. Before distributing his income among different commodities or between savings and spending, the individual consumer must first allocate a portion to meet his necessary living costs. Messrs. Roos and von Szeliski estimate the subsistence or necessitous living cost to have been $200 per capita for 1923 and to have varied in other years with the National Industrial Conference Board index of the cost of living.

Deducting these costs from disposable consumer income, they obtain estimates of "supernumerary income" which is available for expenditures on automobiles and other goods (Table 4, Column 5).

It will be observed from Charts 3 and 4 that for a given amount of disposable or supernumerary income the sales of automobiles are characteristically much higher when income is rising than when it is falling. The reason for this has long been known. The demand for automobiles, as for most durable goods, depends not only on the level of income but on psychological factors such as the state of confidence. Declining business activity and decreasing income give rise to uncertainty and to fears that income will decline still further. As a result, even relatively high levels of income may be associated with a low volume of sales. Conversely, increasing business activity and income lead to increased confidence, and to the allocation of an increasing proportion of present and future income to automobile purchases.

The rate of change of the national income may be taken as an approximate index of this psychological factor. If the rate of change, as well as the level of

CHART 3



national income, is taken into account, the relationship to sales is seen to be much closer than appears from the use of national income alone.[18] Although the introduction of the rate of change of the national income as a factor in the analysis does help to explain variations in the demand for automobiles, it is not an entirely satisfactory measure of consumer confidence, since other phenomena have appreciable influence on the psychological reactions of automobile buyers. A given rate of change may have little effect on sales at one time and a great effect at another. The rate of change in income is, therefore, at best only an approximate index of these psychological factors.

(2) *Potential New Owners and the Maximum Ownership Level.*—The concept of Messrs. Roos and von Szeliski of potential new ownership and of the maximum ownership level is an important contribution to the analysis of the demand for automobiles, since it not only explains the relationship between income and automobile sales but also presents a logical analysis of the major forces determining the sales of automobiles.

Briefly summarized, their explanation is as follows:

(a) At any given time under given economic conditions there is a maximum number of cars that will be kept in operation. In the long run, changes in this

[18] S. L. Horner, *op. cit. supra.*

maximum ownership level depend, of course, on the growth of population, on the development of highways, and on technical progress. From year to year, however, the level changes in response to the economic status of consumers, and to other factors such as price and durability of the car.

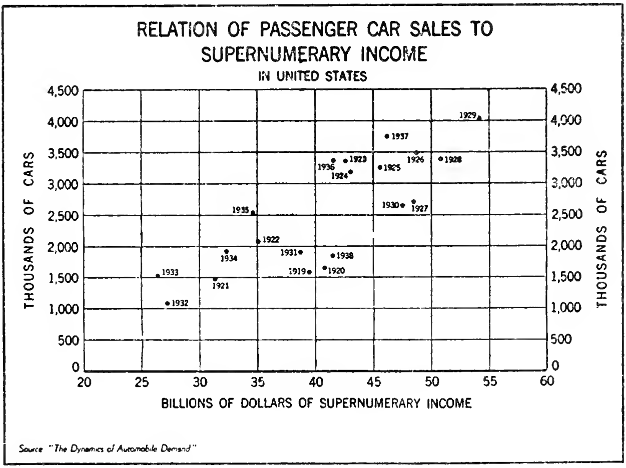
(b) The number of potential new owners is equal to the difference between the maximum ownership level and the existing consumers' stock of cars.

(c) The number of new owner sales is proportional to the number of potential new owners, and to factors dependent on income, price, trade-in allowance, volume of installment credit, and similar factors.

(d) Thus the demand factors are made to enter twice in the analysis of automobile sales, first in determining tl. maximum ownership level under any given set of economic conditions, and secoı d in determining the nature of the reaction of sales to changes in the number of] otential new owners.

(e) By means of these concepts, the relationship between income and automobile sales is explained. Assuming other factors to remain constant, the maximum ownership level at any given time depends on the level of income at that

CHART 4



time, but the stock of cars in operation depends on previous income. The number of potential new owners is the difference between the maximum ownership level and the stock of cars in operation and depends therefore on the difference between this year's and previous years' income. Thus, while it is the change in income from past levels which determines the number of potential owners, it is the current level of income which determines the relation between the volume of sales and the number of potential new owners.

(f) The maximum ownership level is a potent force in determining the volume of new car sales. A sudden increase in income may increase the maximum ownership level to a figure far above the number of cars in operation and thus lead to a very large increase in car sales. This is undoubtedly what happened in 1937. On the other hand a sudden decline in income may decrease the maximum ownership level to a figure below the number of cars in operation. In that case there will be an actual liquidation of part of the stock of cars in operation. This is what happened during the depression years 1930–32.

(3) *Replacement Demand.*—Messrs. Roos and von Szeliski's theory with respect to replacement demand is as follows:

(a) Not only do consumers adjust the *number* of cars in operation towards the maximum ownership level, but they also adjust the *quality* of the cars in operation towards some optimum level by means of replacement.

(b) Replacement demand depends on the pressure for replacement, and on such economic factors as price, income and trade-in allowances.

(c) The age distribution of the cars in operation combined with experience tables for scrapping furnishes a measure of the pressure for replacement. The studies of car survival which have been made since 1926 show that car life during the last fifteen to twenty years has slowly increased. Griffin's study of 1926 shows 50% of the cars surviving about seven years, whereas the most recent study based on 1933-37 registrations shows 50% surviving about nine years. From these studies may be computed the percentage of an original group of cars that is scrapped after the first, second, third, etc., year of service. By application of these percentages to the figures giving the age distribution of the cars in operation in any year a measure of the replacement pressure during that year is obtained. This index represents the theoretical scrapping rate.[19]

(d) Theoretical scrapping, however, merely indicates normal replacement pressure. It is not equal to actual replacement since this varies with economic circumstances. In times of prosperity people scrap more cars than is indicated by theoretical scrapping. The converse is true in periods of depression. Thus in 1929 actual scrapping was about one-third higher than theoretical scrapping, whereas in 1933 it was about 60% lower than the theoretical rate.[20] Replacement sales therefore depend not only on theoretical scrapping but on income and price and other economic factors.

(4) *The Price of Automobiles.*—The almost continuous reduction (until 1933) of car prices (Appendix Table 12) undoubtedly contributed significantly to the great development of the automobile industry. The effect which price changes have on year to year changes in sales is, however, a more difficult question.

One of the major difficulties encountered is the fact that manufacturing specifications change so frequently. Since price changes do not occur separately but in conjunction with changes in car models, it is impossible to segregate satisfactorily the influence of price changes on car sales.

A second difficulty in analyzing the effect of price changes is the fact that there have not been sufficiently wide fluctuations in car prices to warrant very reliable conclusions. A long-run decline in car prices has been associated with a long-run increase in sales. But since year to year changes in price have not been large, it is difficult to discover what effect they have had on year to year changes in sales.

Another major problem in any statistical analysis of the effects of changes in car prices upon volume of sales is the construction of a price index. Automobiles have improved so rapidly in quality, and the changes in design and construction have been so frequent, that it is next to impossible to construct a satisfactory price index. The Bureau of Labor Statistics index of wholesale prices, which is an average of prices of different makes, has been shown to be seriously in error.[21] The index used by Roos and von Szeliski is the average delivered price of the lowest priced cars freely available in volume (Ford, Chevrolet, and Plymouth). Their assumption underlying the use of this index is that this average price determines the number of cars sold, and that the prices of other cars merely determine the distribution of sales among the various makes.[22]

Roos and von Szeliski conclude that price has not been a very important factor in determining automobile sales. The usual measure of the responsiveness of quantity sold to price is the elasticity of demand, or the ratio of the percentage change in the quantity sold to the percentage change in price. It was found that this elasticity was not constant but varied from year to year with changes in economic conditions, particularly with changes in income and in the maximum ownership level.

The figures below give the statistical estimates on the elasticity of demand for the years 1919-1938:

TABLE 5.—*Elasticity of Demand for Automobiles with Respect to Price, 1919-1938*

1919	1.03	1926	1.26	1933	1.30
1920	1.04	1927	1.33	1934	1.34
1921	1.04	1928	1.37	1935	1.34
1922	1.05	1929	1.41	1936	1.33
1923	1.05	1930	1.51	1937	1.38
1924	1.15	1931	1.46	1938	1.53
1925	1.22	1932	1.44		

Source: Roos and von Szeliski, *The Dynamics of Automobile Demand*, p. 94.

[19] See Roos and von Szeliski, *op. cit. supra*, pages 47-53.
[20] See Roos and von Szeliski, *op. cit. supra*, page 52, chart 15.
[21] A. T. Court, "Hedonic Price Indexes", *The Dynamics of Automobile Demand*, pages 99-103.
[22] This index is available only since 1926. For the years 1919-25 the Bureau of Labor Statistics index was used.

These are presented as the *best* estimates of the elasticity of demand. The authors point out that the elasticity may be anywhere between .65 and 2.5, and that 1.5 is probably a good representative figure. It will be noted that there has been a long-run tendency for the elasticity to increase except in periods of depression.

For comparison, there are given below their findings on the income elasticity or the responsiveness of demand to changes in supernumerary income.

TABLE 6.—*Elasticity of Demand for Automobiles with Respect to Income, 1919–1938*

1919	1.55	1926	2.08	1933	2.19
1920	1.55	1927	2.20	1934	2.19
1921	1.56	1928	2.25	1935	2.20
1922	1.61	1929	2.39	1936	2.25
1923	1.69	1930	2.62	1937	2.40
1924	1.80	1931	2.57	1938	2.58
1925	1.94	1932	2.44		

Source: Roos and von Szeliski, *The Dynamics of Automobile Demand*, p. 89.

Since the income elasticity is considerably higher than the price elasticity it is evident that the influence of price on sales is not sufficiently powerful to overcome the effect of the wide swings in income during the business cycle. Even if the price elasticity were equal to the income elasticity, it would require a 50% reduction in price to offset a 50% decline in income. Since cash costs for raw materials, tools, wages, salaries, taxes, and other out of pocket expenses constitute about 90% of the wholesale price of a car it is obvious that such reduction in price unaccompanied by a reduction in costs would be disastrous.[23]

B. SECONDARY FACTORS AFFECTING RETAIL SALES

The factors listed above account for all but a small part of the annual variation in retail sales of automobiles. There are, however, some secondary factors which are highly correlated with those we have considered and whose infleucnce it is therefore difficult to segregate from the rest. In certain years these forces may be of particular importance in stimulating or discouraging sales.

(1) *Used Car Allowances.*—The used car allowance is one such factor. Since the net cash cost to the buyer of a new car is the difference between the new car price and the used car allowance, it is obvious that the size of the the allowance must affect new car sales. In the statistical study made by Roos and von Szeliski it was, however, impossible to measure this effect.

(2) *Financing Terms.*—Financing terms have become progressively easier. The percentage of installment contracts running more than 12 months rose from 14.5% in 1928 to 68% in 1937. The percentage of down payments that were under standard terms (33⅓% on new cars, 40% on used cars) rose from 6.1% to 23.3% during the same period. Beginning in 1935 the easing of financing terms was particularly marked.[24] This undoubtedly has had an important effect on the increased volume of purchases of new cars since 1935.

(3) *Operating Costs.*—Operating costs are particularly important as a long-run trend factor determining the maximum level of ownership. The better the quality of the car and the lower the annual operating and maintenance costs, the greater is the number of cars that will be kept in operation.

Operating costs were not included as a separate variable in the statistical study. The variation in operating costs has, however, closely paralleled the variation in automobile prices, and it is difficult therefore to separate their respective effects on the volume of automobile sales. Roos and von Szeliski have made estimates of the elasticity of demand for automobiles[25] when the effects of operating costs are included and also when they are excluded. It is the latter series which has been used in the section on prices (Table 5).

(4) *Dealers' Used Car Stocks.*—Dealers' used car stocks undoubtedly have important effects on sales of new cars in some years. When used car stocks are large, dealers tend to push the sales of used cars with greater vigor, and they lower their trade-in allowances. Both of these have a depressing effect on sales of new cars. Unfortunately no data are available on the number and value of used cars in dealer hands, and it is difficult to get any statistical evidence on this point. However, even a superficial examination of the automotive journals indicates that this is at times a major problem.

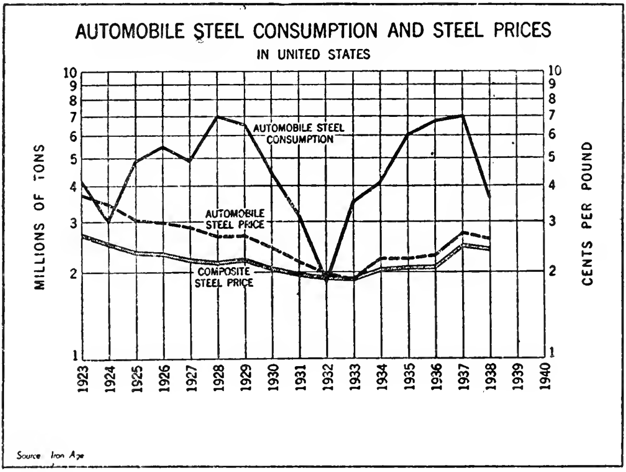
[23] See S. M. Dubrul, "Significance of the Findings", *Dynamics of Automobile Demand*, pages 123–39.
[24] Roos and von Szeliski, *op. cit. supra*, page 68.
[25] Roos and von Szeliski, *op. cit supra*, pages 92, 94.

VI. The Relation of Steel Prices to the Demand for Automotive Steel

Since automotive steel is purchased primarily as a raw material for the production of cars, consumption of steel by the automotive industry bears a direct relation to production of cars. This is illustrated by the data on automobile production and steel consumption [26] in Chart 2. In almost every year from 1923 to 1938 the two series moved in the same direction and had approximately the same relative magnitude of fluctuation. For the period as a whole, however, there was a long-run tendency for the consumption of steel to increase by a greater percentage than automobile production. This is shown by the upward trend in steel consumption per automobile (Table 7).

In contrast to the close relationship between steel consumption and automobile production, there is little, if any, relation between steel consumption and steel prices. This is illustrated graphically in Chart 5, in which both the composite steel price and the simple average of sheet and strip prices are plotted.[27] The consumption

Chart 5



series (Appendix Table 9) and price series (Appendix Table 10) move in the same direction about as often as they move in the opposite direction.

This conclusion is further supported by Chart 6, a scatter diagram of automotive steel consumption against automotive steel prices. In this chart, percentage changes in annual consumption and annual average price are shown in relation to each other. Since the scatter diagram fails to indicate that lower steel prices have been associated historically with greater quantities of steel purchased and vice versa, it justifies the view that price has been less important than other influences in determining the consumption of automobile steel.

As was pointed out earlier in the discussion, the quantity of steel consumed as a raw material in the automobile industry depends directly upon three factors:

(1) The number of cars produced;
(2) The quantity of steel used per car;
(3) The production of replacement parts and accessories.

A change in the price of steel can, consequently, affect the consumption of steel only as (1) it leads to a corresponding change in the price of automobiles and thus

[26] See Note 13 regarding limitations of data.

[27] See Table 10 in the Appendix for these prices. This average of hot and cold rolled sheet and hot rolled strip prices is henceforth referred to as the automotive steel price. A simple average of the prices of these steels was taken because (1) they are the most important kinds of steel used in making automobiles and (2) they are used in about equal amounts per car.

to an inverse change in the number of automobiles sold, or (2) it induces the manufacturers of automobiles to change the quantity of steel used per car, or (3) it causes a change in the production of replacement parts and accessories.

Considering first the influence of steel prices on automobile prices and production, we find it impossible to determine directly from an examination of steel prices whether a change in the price of steel used by the automobile industry has had any direct effect on the price of automobiles. (See Chart 7 and see Table 12 in the Appendix.) The statistics show merely that both series of prices moved in a long-run downward trend until 1933, and thereafter moved horizontally or upward. It will be observed also that the movements in these price series were not greatly different from the movements of a broad price index of manufactured goods during the same period. From this statistical evidence it is impossible to infer whether changes in the price of steel did or did not cause changes in automobile prices.

It is possible, however, to discover the extent to which steel prices might affect car prices by an analysis of the cost of steel in an automobile. As is shown in

CHART 6

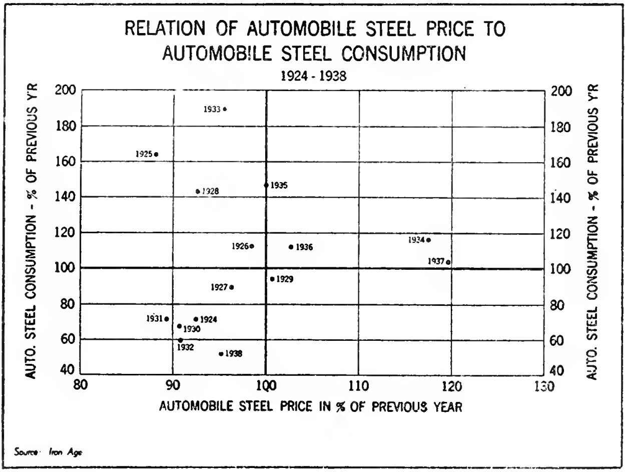


Table 11 in the Appendix, the cost of steel used in the manufacture of a Chevrolet sedan is approximately 13% of the F. O. B. price or approximately 10% of the delivered price of the car.[28] A reduction of 10% in the price of automotive steel would therefore permit a reduction of only 1% in the delivered price of the car if the reduction were passed on entirely to the consumer. The effect of changes in car prices on car sales has been studied by Roos and von Szeliski, and their estimates of the elasticity of demand for automobiles appear in Table 5 of this memorandum. Their figure of 1.5 for the elasticity of demand for automobiles means that a 1% change in the price of automobiles gives rise to a 1.5% change in the number of automobiles sold. Since a 10% reduction in the price of steel, if passed on entirely to the buyer, is equivalent to only a 1% reduction in the price of the car, it would increase the volume of car sales and therefore the consumption of steel by only 1.5%. Even if the maximum limit of 2.5 estimated by Roos and von Szeliski be taken as the elasticity of demand for automobiles, the effec of a 10% drop in the price of steel, if passed on to the consumer, would be to increase

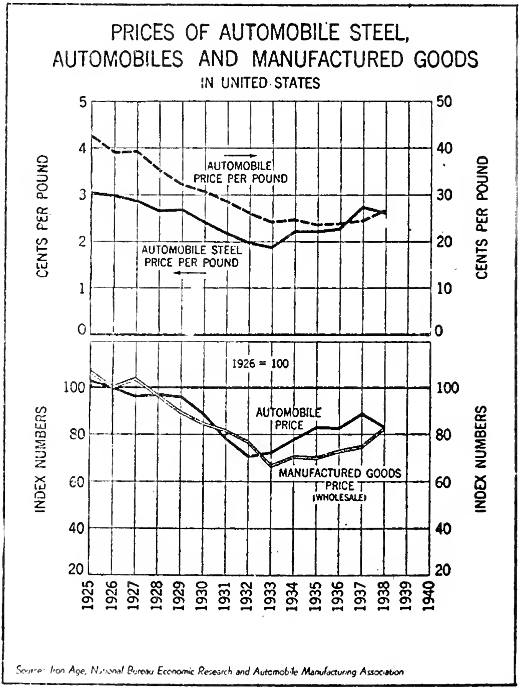
[28] In heavier, higher priced automobiles the quantity of steel used does not increase proportionately with price, and consequently the ratio of steel cost to retail price falls below 10%.

car sales and automotive steel consumption by only 2.5%.[29] It is evident, therefore, that a reduction in the price of steel is not an effective means for raising steel consumption through increases in car sales and car production.

The effect of a reduction in the price of steel on the quantity of steel used per car is, so far as can be determined, practically negligible. During the past fifteen years a number of factors have contributed to an increased use of steel per car. These are:

(1) The increased popularity of enclosed models and heavier cars;
(2) Engineering improvements in the production of both steel and automobiles;

CHART 7



(3) Intense competition among motor companies pointed toward improvement of their product.

There is, however, no logical or statistical basis for inferring that the price of steel has been a significant factor in causing the increased use of steel per car.

Unfortunately, the statistical series available on the steel consumption per automobile are none too satisfactory. Attempts to derive such a series from the estimates of steel consumption by the automobile industry appearing in the

[29] It might appear that a reduction in the price of automobiles made possible by a general decrease in all cost components would be an effective means of stimulating automobile purchases. The elasticity figures here quoted, however, do not apply to price reductions accompanied by a general deflation in the prices of the cost factors throughout the economy. The effects of general deflation in prices and costs are too complicated and complex to explore here.

trade magazines, *Iron Age* and *Steel*, led to the conclusion that these estimates were too inaccurate for this purpose.[30] Resort was had, therefore, to estimates of the average dry shipping weight of all passenger cars as an index of the quantity of steel per car.

TABLE 7.—*Average Dry Shipping Weight of all Passenger Cars, 1920–1938*

[Weighted by new car registrations]

Year:	Weight in Pounds	Year:	Weight in Pounds	Year:	Weight in Pounds
1920	2373	1927	2486	1934	2691
1921	2223	1928	2587	1935	2791
1922	2324	1929	2623	1936	2881
1923	2348	1930	2598	1937	2871
1924	2338	1931	2682	1938	2918
1925	2356	1932	2769		
1926	2412	1933	2599		

Source: Data from private sources. Approximately the same data for 1925 to 1938 is obtained from *Automobile Facts and Figures* (1939), p. 48, by dividing average price per car by average price per pound.

CHART 8

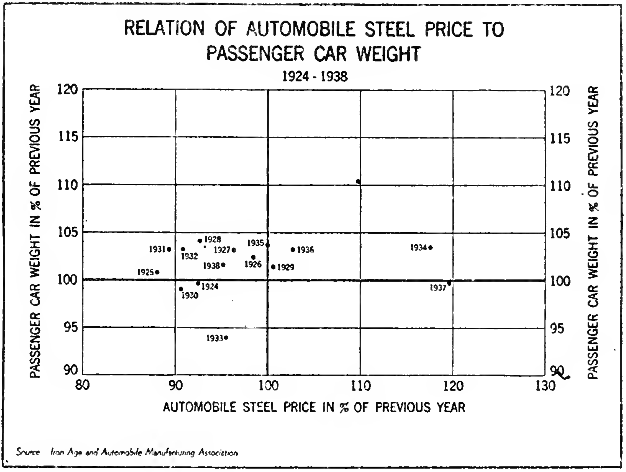


Chart 8 compares the average car weight with an index of typical automotive steel prices [31] in order to determine what relationship exists between them. In order to eliminate the trend in both series, annual percentage changes instead of the original figures are plotted against each other. This chart does not disclose any relationship of car weight to steel prices. This lends support to the conclusion that the quantity of steel used per car depends primarily upon technical factors and long-run trends in taste rather than upon changes in the price of steel.

In the discussion thus far there has been no consideration of the elasticity of the demand for steel in the accessories and parts industry. It is reasonable to suppose, however, that the elasticity of demand for steel in this industry is about the same as in the automobile industry. In any event, since the value of the production of parts and accessories is only about one-seventh of the value of the production of cars, the elasticity of demand for steel in both industries taken

[30] See note 13 regarding the quality of the data.
[31] Weights from Table 7, prices from Table 10 in the Appendix.

toegther is not much different from the elasticity of demand for steel in the automobile industry alone.[32]

To sum up: The elasticity of demand for steel used as a raw material in the automobile industry is very low, probably no higher than .2 or .3. A 10% reduction in the price of automotive steel, if passed on to the ultimate consumer, would lead to approximately a 1.5% increase in the consumption of steel directly attributable to increased car sales, and possibly to a very slight additional increase directly attributable to increased weight per car. Considering these combined effects, a 10% reduction in the price of automotive steel would probably not increase its consumption by more than 2% or 3%.

If automotive steel sold for $60 a ton before such a 10% price reduction, a maximum increase of 3% in automotive steel consumption resulting therefrom would mean that the steel producer would sell 1.03 tons of steel where he formerly sold one ton, but for such increased quantity he would receive, under the reduced prices of $54 a ton, only $55.62 as compared with his earlier sales return of $60 for a smaller quantity. Consequently a reduction in steel prices would decrease the gross revenues, increase the operating expenses and greatly reduce the net income of the steel industry.

Automobile sales have slumped in depression because of reduced consumer income and fear and uncertainty of the future. Against these tidal forces a reduction in the price of automotive steel could have no significant effect.

Appendix

TABLE 8.—*Production of Cars and of Automobile Parts and Accessories, and Total Number of Cars Registered, 1921–1933*

Year	Production of Auto Parts and Accessories at Producers' Prices [1]		Production of Cars at Producers' Prices [1]		Total Number of Cars Registered [2]	
	(millions of dollars)	1926=100	(millions of dollars)	1926=100	(Millions)	1926=100
1921	$169	38.4	$1,147	42.8	10.5	47.7
1922	243	55.2	1,596	59.6	12.2	55.5
1923	356	80.9	2,278	85.0	15.1	68.6
1924	337	76.6	2,034	75.9	17.6	80.0
1925	444	100.9	2,524	94.2	19.9	90.5
1926	440	100.0	2,679	100.0	22.0	100.0
1927	420	95.5	2,175	81.2	23.1	105.0
1928	412	93.6	2,557	95.4	24.5	111.4
1929	408	92.7	2,800	104.5	26.5	120.5
1930	326	74.1	1,643	61.3	26.5	120.5
1931	273	62.0	1,124	42.0	25.8	117.3
1932	212	48.2	627	23.4	24.1	109.5
1933	228	51.8	757	28.3	23.9	108.2

Sources:
[1] S. Kuznets, *Commodity Flow and Capital Formation*, National Bureau of Economic Research, New York, 1938, p. 137. The estimates of auto parts and accessories exclude original equipment used in the production of new cars. Data not available for years subsequent to 1933.
[2] *Automobile Facts and Figures*, Automobile Manufacturers Association, 1938, p. 16.

[32] The cost of steel in tools and dies is a negligible part of the total cost of an automobile and is, therefore, disregarded in this study.

TABLE 9.—*Automobile Production and Steel Consumption, 1923–1938*

Year	Production of Motor Vehicles [1]		Automotive Steel Consumption [2]		Steel Consumption per Motor Vehicle Produced [3]
	(thousands of units)	1929=100	(thousands of gross tons)	1929=100	(gross tons)
1923	4180	74.4	4182	63.9	1.000
1924	3738	66.5	2981	45.5	.797
1925	4428	78.8	4886	74.7	1.103
1926	4506	80.1	5486	83.8	1.217
1927	3580	63.7	4895	74.8	1.367
1928	4601	81.8	6963	106.4	1.513
1929	5622	100.0	6565	100.0	1.164
1930	3510	62.4	4406	67.3	1.255
1931	2472	44.0	3149	48.1	1.274
1932	1431	25.5	1864	28.5	1.303
1933	1986	35.3	3530	53.9	1.777
1934	2870	51.1	4101	62.7	1.429
1935	4120	73.3	6016	91.9	1.460
1936	4616	82.1	6712	102.2	1.454
1937	5016	89.2	6977	106.6	1.391
1938	2655	47.2	3619	55.3	1.363

Sources:
[1] *Statistical Abstract of the United States*, 1938, p. 370. 1938 figure from *Automobile Facts and Figures*, 1939, p. 4.
[2] Computed by apportioning individual hot-rolled product totals on the basis of *Iron Age* distribution reports and by allocating jobber shipments to ultimate consumers. See M. W. Worthing, *Distribution of Steel Products to Major Consuming Industries*, United States Steel Corporation, October 30, 1939.
[3] Considered less reliable as an index of steel used per car than the average dry shipping weight shown in Table 7.

TABLE 10.—*Steel Prices, 1923–1938*

[Cents per pound]

Year	Hot-rolled Strip	Hot-rolled Sheets No. 10 Gage	Cold-rolled Sheets	"Automotive Steel" Price (average of the three prices) [1]	*Iron Age* Composite Steel Price
1923	3.04¢	2.96¢	5.19¢	3.73¢	2.697¢
1924	2.57	2.79	5.00	3.45	2.505
1925	2.27	2.45	4.39	3.04	2.334
1926	2.30	2.37	4.30	2.99	2.315
1927	2.26	2.20	4.17	2.88	2.202
1928	1.93	2.04	4.03	2.67	2.165
1929	1.88	2.12	4.06	2.69	2.209
1930	1.68	1.99	3.64	2.44	2.048
1931	1.54	1.86	3.13	2.18	1.957
1932	1.43	1.71	2.80	1.98	1.901
1933	1.58	1.62	2.48	1.89	1.879
1934	1.85	1.85	2.96	2.22	2.033
1935	1.85	1.85	2.95	2.22	2.058
1936	1.91	1.92	3.02	2.28	2.077
1937	2.35	2.35	3.49	2.73	2.464
1938	2.25	2.25	3.31	2.60	2.394

Source: *The Iron Age*, Annual Statistical Supplement, reprinted from the January 5, 1939, issue, pp. 8–10.

[1] A simple average of the prices of these three steels was taken as the average automotive steel price because (1) they are the most important kinds of steel used in making automobiles and (2) they are used in about equal amounts per car. See Table 11

TABLE 11.—*Net Cost of Steel Products Used in Construction of Chevrolet Sedan, 1938*

[F. O. B. Flint Price $595.00—New York Delivered Price $730]

Steel Products Used		Analysis of Steel Cost July 14, 1938	
Product	Weight in pounds	Price at Detroit	Cost of product for one auto
Pig iron—foundry	144.0	$20.50 G. T.	$1.31
Pig iron—Malleable	162.0	20.50 G. T.	1.48
Terne plate	23.0	3.85 per 100#	0.89
Plates	15.8	2.32 per 100#	0.37
Bars—cold drawn	45.0	3.15 per 100#	1.42
Sheet bars	17.0	37.32 G. T.	0.28
Billets—forging	278.0	45.00 G. T.	5.58
Sheets—cold rolled	554.0	3.35 per 100#	18.56
Sheets—hot rolled	531.0	2.925 per 100#	15.53
Strip—cold rolled	98.9	3.77 per 100#	3.73
Strip—hot rolled	509.2	2.65 per 100#	13.49
Strip—chrome nickel	0.2	30.29 per 100#	0.06
Alloy bars—cold drawn	23.6	4.575 per 100#	1.08
Alloy bars—cold finished	0.9	4.575 per 100#	0.04
Alloy bars	284.2	3.50 per 100#	9.95
Bessemer ferro silicon	0.6	38.42 G. T.	0.01
Ferro manganese	0.6	99.54 G. T.	0.03
Cast iron	19.0	11.75 G. T.	0.10
Nails	6.0	3.47 per 100#	0.21
Tacks	1.0	9.58 per 100#	0.10
Rivets	6.0	3.47 per 100#	0.21
Wire rods	2.3	51.32 G. T.	0.05
Bright wire	7.8	3.82 per 100#	0.30
Spring wire	70.8	3.77 per 100#	2.64
Total products listed	2800.1		[1] $77.42

[1] $77.42 is about 13% of $595 and about 10% of $730.

Source: Data on steel products used were taken from *Mill and Factory*, June, 1938, p. 96, and were supplemented by conversations with persons in the automobile industry. Data on prices were prepared by United States Steel Corporation.

TABLE 12.—*Automobile Prices, Automotive Steel Prices and Prices of Manufactured Goods, 1919–38*

Year	Retail Passenger Car Price [1] (dollars per car)	Retail Passenger Car Price [1] (cents per pound)	Automotive Steel Price [2] (cents per pound)	Index of Wholesale Prices of Manufactured Goods [3] (1913=100)
1925	$1007	42.7¢	3.04¢	162.4
1926	943	39.1	2.99	157.5
1927	977	39.3	2.88	152.0
1928	911	35.2	2.67	153.1
1929	843	32.1	2.69	151.5
1930	798	30.7	2.44	140.4
1931	767	28.4	2.18	123.?
1932	723	26.1	1.98	111.5
1933	630	24.2	1.89	113.8
1934	664	24.7	2.22	126.0
1935	658	23.6	2.22	130.9
1936	687	23.8	2.28	130.3
1937	704	24.5	2.73	139.8
1938	779	26.7	2.60	130.9

Sources:

[1] Taken from *Automobile Facts and Figures*, A. M. A. 1939, p. 48. Represents delivered price at factory of the cheapest four or five passenger closed models of each make, weighted by new car registration.

[2] From Table 10.

[3] Taken from F. C. Mills, *Prices on Recession and Recovery*. National Bureau of Economic Research, 1936. Appendix III, pp. 491–2. Figures for 1936–1938 from National Bureau of Economic Research.

EXHIBIT No. 1414

AN ANALYSIS OF THE DEMAND FOR STEEL IN THE RAILROAD INDUSTRY

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I. PURPOSE

The purpose of this study is to review the factors which influence the railroads' demand for steel, to analyze their relative importance, and in particular to appraise the role of price in the consumption of steel by the railroads.

II. FINDINGS

(1) The railroads' demand for steel is derived from the demand for railroad services, which in turn depends primarily upon the national income and the competition from alternative means of transportation.

(2) Due to the durability of railroad equipment, changes in the demand for railroad services generate much greater fluctuations in the demand for equipment and hence in the consumption of steel by the railroads.

(3) Capital expenditures for rolling stock and other equipment requiring steel are ultimately dependent on the demand for rail transportation; but in the short run they are determined by the adequacy of existing facilities for current traffic needs and by the funds available for such outlays. When the demand for railroad services declines, there is less need for capital expenditures on rolling stock and other equipment which require steel in their production, and also railroads have less funds available for such expenditures.

(4) The consumption of steel for maintenance purposes is closely related to the volume of traffic currently handled by the roads.

(5) Price is of minor importance in determining the consumption of steel by the railroads. This is emphatically true of aggregate steel purchases over a considerable period of time. It follows from two facts:

(a) the demand for transportation services for freight and for passengers certainly has a low elasticity, probably less than unity. This means that a given percentage change in rates probably will have a smaller proportionate effect on the volume of railroad services. The effects of rate changes, however, may vary among railroads and different sections of the country.

(b) the cost of steel is a comparatively small fraction of the total cost of transportation service, and consequently has little effect on the price (i. e., rates) or volume of railroad services.

(6) Even with respect to cyclical timing of steel purchases, price is not a major influence. Capital equipment is purchased when it is needed and can be profitably employed, and when funds are available. Maintenance is determined partly by the requirements of traffic and partly by the revenues which can be used for this purpose. In a depression, purchases are reduced to conform to current needs. In their dire financial straits the railroads are in no position to speculate on possible fluctuations in steel prices by making purchases not required by current needs.

(7) The low consumption of steel by the railway industry in the last decade has been due to the declining trend in rail transportation, the severe depression in business and the poor financial conditions of the railroads. No conceivable reduction in price of steel to the railroads could have counteracted these forces to a substantial extent.

III. The Railroad Industry

Any attempt to determine the railroads' demand for steel must start with some analysis of the railroad industry. As the chief agency for transportation, railroads have been indispensable in the national economy. They are also of great importance as sources of employment, investment and consumption.

The railroads have recently been in a stage of transition from an expanding to a declining industry. The periods of experimentation between 1830 and 1850, of rapid expansion from 1850 to 1890, and of subsequent development of particular areas and of feeder and cross lines have, since the World War, been followed by an era of shrinkage in railroad mileage, severe competition from other transportation agencies, and declining trends in operating revenues. In recent years the financial position of most railroads has been seriously impaired; approximately one-third of the railroad mileage of the United States is in bankruptcy,[1] and in 1938 only a few roads earned all their fixed charges.

IV. Factors Affecting Steel Consumption by the Railroads

The decline in railroad operations has been accompanied by a decline in the railroads' consumption of steel. The railroads had long been the leading customers of the steel industry, but during the past ten years the purchases of steel by the railroad industry have declined absolutely and relatively. Whereas in 1923, the railroads consumed approximately 25.4% of all the finished steel produced and ranked first as a consuming group, by 1932 they consumed approximately 10% of the finished steel produced and ranked third as a consuming group. In 1938 they consumed only 6.1% of the total finished steel produced in the United States.[2]

Railroads use a variety of steel products for many different purposes. Their purchases range from rails, plates and structural shapes to bolts, nuts, washers and rivets. In general, steel is now consumed by the railroads in the form of new locomotives and cars and as material for the maintenance of way, structure and equipment.

The demand for steel by the railroads is derived from the demand for freight and passenger transportation services, which exhibit marked cyclical fluctuations. It is this fact which accounts for the great fluctuations in the purchases of steel by railroads. These fluctuations are further intensified by the durability of the steel products used by the railroads, and by the limitations of impaired financial condition and the reduced operating revenues experienced in periods of depression by the railroads. These relationships are set forth in more detail in the following analysis.

A. Freight Traffic

Freight traffic rose gradually during the 1920's, reaching a peak of 450 billion ton-miles of railroad revenue freight in 1929.[3] In the depression low of 1932 it fell to 235 billion ton-miles. By 1937 freight traffic had recovered to 363 billion ton-miles, but for the year ended June 30, 1938, it declined again to 313 billion ton-miles.[4]

It has long been recognized that freight car loadings are closely related to industrial production. This is to be expected, for freight car loadings include mainly industrial products and industrial raw material such as coal, coke, forest products and ore. Chart 1 shows this close relationship between industrial production and miscellaneous and merchandise freight car loadings.[5] By statistical analysis the National Resources Committee found that fluctuations in freight traffic were almost completely explained by fluctuations in industrial production.[6]

The evidence points strongly to the conclusion that the demand for rail freight transportation has a rather low elasticity. First, the very close dependence of rail freight traffic on business activity lends support to this conclusion.

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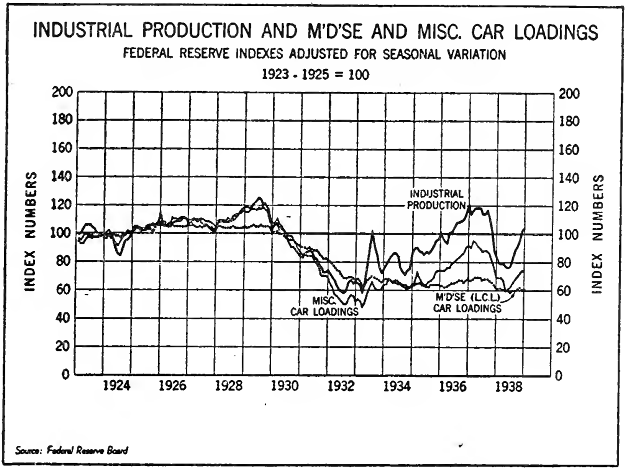
[1] See *infra*, Table 2.
[2] See Appendix, Table 7.
[3] See Appendix, Table 8.
[4] See Appendix, Table 8.
[5] See also Appendix, Table 9. Miscellaneous and merchandise (l. c. l.) freight car loadings were used, since they cover industrial products more directly than the combined index of freight car loadings which includes agricultural products and livestock.
[6] Industrial Committee of the National Resources Committee, *Patterns of Resource Use* (1939), p. 99. It was found that ninety-seven percent of the variation in freight traffic was explained by variations in industrial production and a time trend.

Second, the demand for freight transportation is derived from the demand for the goods to be transported and must have a low elasticity because transportation charges are not usually a large fraction of total value of goods carried. The availability of substitute means of transportation tends to increase the elasticity of demand for rail freight service, but it should be noted that the possibilities of substitution are limited by technical obstacles. Furthermore, from a broader point of view the substitution of one transportation agency for another does not greatly affect the elasticity of demand for total transportation or for the steel consumed by all transportation agencies.

Although the movements of the two series have been much alike, freight car loadings have not kept pace with industrial production, especially since the depression low of 1932. The failure of the freight car loadings to recover as rapidly as industrial production since 1932 has been due largely to the diversion of traffic

CHART 1



from the railroads to trucks, waterways, and pipe lines. This shift from the railroads to the other commercial forms of transportation is evident from the following table:

TABLE 1.—*Distribution of Freight Traffic by Commercial Agencies, 1926 and 1937*

Agency	Amount Millions of Revenue Ton-Miles		Percent of Total Ton-Miles	
	1926	1937	1926	1937
			Percent	*Percent*
Steam Railways	447,443	362,815	75.4	64.6
Intercity Trucks	23,530	43,380	3.9	7.7
Great Lakes	90,038	93,244	15.2	16.6
Other Inland Waterways	9,543	16,883	1.6	3.0
Pipe Lines	21,700	44,793	3.7	8.0
Electric Railways }	1,313 }	697 }	0.2	0.1
Airways }	Nil }	2 }		
Total	593,567	561,815	100.0	100.0

Source: *Report of Committee*, Appointed Sept. 20, 1938, by the President of the United States to Sub Recommendations upon the General Transportation Situation (1938), pp. 44–6.

These data show that the proportion of the commercial freight business handled by the railroads declined from three-fourths of the total in 1926 to less than two-thirds in 1937. While the railroads handled 84.6 billion ton-miles of freight less in 1937 than in 1926, the intercity trucks, the waterways, and the pipe lines increased their freight ton-miles by 19.9, 10.5 and 23.1 billion ton-miles, respectively. In percentage terms, there was a decrease of 18.9% in the freight ton-miles handled by the railways between 1926 and 1937.

B. PASSENGER TRAFFIC

Passenger traffic has exhibited a severely declining trend since 1923, when revenue passenger miles had reached an all-time peak (excluding the period of federal control). By 1937 passenger traffic had dropped 35% from its 1923 level, in spite of an increase of 16% in population and a rise of 24% in consumers' income (in 1936 dollars).[7] This marked downward trend in passenger traffic has been due mainly to the expansion of other forms of transportation, primarily the automobile; from 1923 to 1937 automobile passenger car registrations increased 88%[8] and passenger car mileage rose more than 50%.

Railroad passenger traffic has been greatly influenced by consumers' incomes.[9] A recent study of the National Resources Committee found that consumers' income was the most important factor in explaining the variations in passenger traffic [10] and that railroad rates were much less important. Its findings indicate that the demand for passenger service was inelastic in that a one per cent reduction in rates would induce about a one-half of one per cent increase in passenger traffic.[11] This inference may not necessarily be the same for all railroads or for different sections of the country but appears to be warranted for total passenger transportation.

Consumers' income and competition from other transportation media, then, are the most important factors explaining fluctuations in passenger traffic. In the depression of the early thirties rail passenger traffic fell to extremely low levels because the cyclical decline in consumers' incomes was reinforced by the continued shift of traffic to other media of transportation. In 1933, revenue passenger miles were less than 50% of their average level during the twenties; in the 1937 recovery that followed, although consumers' income (in 1936 dollars) surpassed its 1929 level, rail passenger traffic failed by 21% to reach its 1929 volume.[12] In the last few years the volume of passenger traffic would probably have been even lower had it not been for marked improvements in the quality of service.

C. FINANCIAL CONDITION

1. *Operating Revenues and Profits.*—Since 1926 the financial condition of railroads has become progressively more critical. This is mainly attributable to a decline in the volume of traffic which became marked beginning with 1930. Total operating revenues reached a peak of 6.4 billion dollars in 1926 and declined to a low of 3.1 billion dollars in 1933. Although in 1937 revenues recovered to 4.2 billion dollars, 35% above the 1933 level, they fell again in 1938 to 3.6 billion, only 15% above the depression low.[13]

This drastic decline in total operating revenues, combined with the smaller reduction in operating expenses and the slower decline in taxes and fixed charges, caused larger deficits.[14] Net income in 1929 amounted to about 900 million dollars, and dropped to a deficit of 140 million in 1932. There were deficits again in 1933 and 1934, and an insignificant net income in 1935. After moderate earnings in 1936 and 1937, the deficit reached over 120 million dollars in 1938. Dividend rates in 1929 and 1930 were 6% of the capital stock outstanding, but in 1932 they were only 1.12%, and even in the best recent year not higher than 2.11%.[15]

[7] See Appendix, Table 10.
[8] See Appendix, Table 11.
[9] See Appendix, Table 10.
[10] Cf. National Resources Committee, *op. cit.*, pp. 90–1 and 99.
[11] *Ibid.*
[12] See Appendix, Table 10.
[13] See Appendix, Table 12.
[14] See Table 2 in text and Appendix, Table 12.
[15] See Appendix, Table 13.

TABLE 2.—*Railroad Operating Revenues, Net Income and Mileage in Receivership, 1928–38*

Year	Operating Revenues [1] (thousands of dollars)	Net Income [2] (thousands of dollars)	Percent of Total Railroad Mileage Operated by Receivers or Trustees [3]
1928	$6,111,736	$786,824	2.02%
1929	6,279,521	896,807	2.19
1930	5,281,197	523,907	3.64
1931	4,188,343	134,762	4.99
1932	3,126,760	139,204	8.71
1933	3,095,404	[4] 5,863	16.24
1934	3,271,567	16,887	16.54
1935	3,451,929	7,539	26.87
1936	4,052,734	164,630	27.57
1937	4,166,069	98,058	28.15
1938	3,565,000	123,000	30.98

Sources:
[1] Figures for operating revenues and net income cover Class I railroads only, while mileage in receivership applies to all railroads.
[2] Based on Reports of Interstate Commerce Commission and Association of American Railroads, Bureau of Railway Economics (*A Review of Railway Operations in 1938*).
[3] Based on Reports of Interstate Commerce Commission.
[4] Deficit.

The unfortunate financial condition of the railroads is forceably demonstrated by the growing percentage of mileage operated by receivers or trustees. Table 2 shows an uninterrupted rise from 2.02% in 1928 to 30.98% in the middle of 1938 in spite of some recovery in operating revenues and net income between 1933 and 1937.

In part, the financial difficulties of the railroads have been due to the inflexibility of certain costs. From 1921 to 1929 an average of 11.0 cents of every dollar of operating revenue went to pay fixed charges; then from 1930 to 1937, this average rose 63% to 17.9 cents.[16] In dollar terms, the expenditures for interest on debt remained fairly stable in the depression; from 518 million dollars in 1931, this expenditure rose to slightly over 525 million dollars in 1932, and gradually fell to 491 million in 1937.[17]

Hourly wage rates have exhibited similar inflexibility. The average hourly wage in 1929 was 66.6 cents; after a drop to a low of 62.9 cents in 1933, it rose to 68.6 cents in 1935 and 70.9 cents in 1937.[18] Since approximately 45% of the average operating revenue dollar is expended for wages,[19] this comparative inflexibility in wage rates has adversely affected the earnings and general financial position of the railroads.

2. *Source of Funds.*—During the relatively prosperous period of the twenties, about 70% of the funds used by the railroads for capital investments were obtained from income, approximately 25% from the issue of securities, and the relatively small remainder from reduction of working capital. During the period from 1931 to 1937, not only was income available for investment greatly reduced, but the capital market was practically eliminated as a source of funds for capital investment; in fact, during this period more securities were retired by the railroads than issued. The following table shows the amount and the sources of the funds for capital purposes from 1921 to 1937:

[16] *Report of the Emergency Board to the President* (October, 1938), p. 15.
[17] See Appendix, Table 13.
[18] *Ibid.*
[19] *Report of the Emergency Board to the President* (October, 1938), p. 30.

TABLE 3.—*Funds for Capital Purposes, Class I Railroads and Their Lessor Companies, 1921–1937*

Period	From Income		From Reduction in Working Capital		From Securities		Total (millions of dollars)	Average Annual Total (millions of dollars)
	Millions of dollars	Percent	Millions of dollars	Percent	Millions of dollars	Percent		
1921–30	$6,003.4	69.10%	$555.1	6.39%	$2,129.5	24.51%	$8,688.0	$868.8
1931–37	1,402.4	86.29	414.6	25.51	[1] 191.8	[1] 11.80	1,625.2	232.2

[1] Deficit.

Source: Compiled from Tables submitted to the Temporary National Economic Committee by J. W. Ballinger III. Record Vol. III, p. 404.

On an annual basis, funds for capital investments derived from income, from reduction in working capital, and from the sale of securities averaged approximately 868 million dollars during the twenties, while the annual average from the same sources during the period from 1931 to 1937 amounted to about 232 million, only about 27% of the level during the more prosperous years.

Apart from the expenditures for capital investment during the period from 1921 to 1937, a further amount of 24.7 billion dollars was necessary to finance maintenance (excluding depreciation and retirement). Of this amount about 18.2 billion was spent during the 1921 to 1930 period and 6.5 billion in the 1931 to 1937 period. On an annual basis, expenditures in the earlier period were 1.8 billion as compared with 0.9 billion dollars during the depression years.[20]

V. DEMAND FOR STEEL BY THE RAILROADS

A. MAINTENANCE AND CAPITAL EXPENDITURES

As a result of the decline in traffic and revenues, the railroads curtailed their expenditures for maintenance and capital equipment. Not only has there been less need for equipment and materials, but there have been less funds available to purchase these materials and equipment. Table 4 shows the drastic curtailments in the subdivisions of the two major groups of expenditures:

TABLE 4.—*Class I—Railroad Maintenance and Capital Expenditures, 1923–1938*

[Millions of dollars]

Year	Maintenance Expenditures			Capital Expenditures		
	Ways and structures	Equipment	Total	Ways and structures	Equipment	Total
1923	$813.7	$1,465.2	$2,278.9	$377.4	$681.7	$1,059.1
1924	792.7	1,260.0	2,052.7	381.1	493.6	874.7
1925	816.4	1,259.8	2,076.2	410.1	338.1	748.2
1926	866.8	1,283.1	2,149.9	513.2	371.9	885.1
1927	868.6	1,219.1	2,087.7	482.9	288.7	771.6
1928	837.9	1,166.9	2,004.8	452.4	224.3	676.7
1929	855.4	1,202.9	2,058.3	532.4	321.3	853.7
1930	705.5	1,019.3	1,724.8	544.3	328.3	872.6
1931	530.6	817.0	1,347.6	288.8	73.1	361.9
1932	351.2	618.9	970.1	130.8	36.4	167.2
1933	322.3	598.7	921.0	88.5	15.5	104.0
1934	365.3	637.9	1,003.2	120.7	92.0	212.7
1935	394.0	681.9	1,075.9	109.0	79.3	188.3
1936	454.8	783.0	1,237.8	139.9	159.1	299.0
1937	495.6	826.7	1,322.3	186.9	322.9	509.8
1938	420.2	676.5	1,096.7	111.5	115.4	226.9

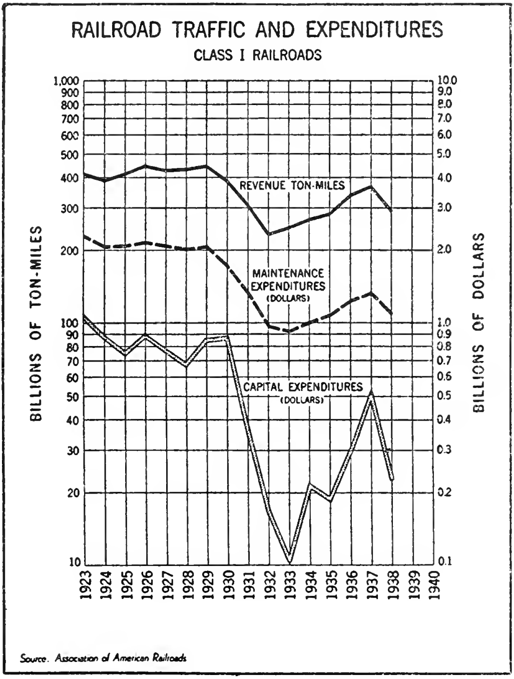
Source: Reports of Carriers to Bureau of Railway Economics and published by Association of American Railroads.

[20] Testimony of J. W. Ballinger, III, before the Temporary National Economic Committee May 17, 1939. Due to the differences in methods of computation, these figures differ slightly from those given in text in Table 4.

1. *Maintenance Expenditures.*—Of the two groups of expenditures, total maintenance outlays constitute about 40% of operating expenses, and, in general, absorb one-third of total operating revenues. If the annual average from 1921 to 1928 is taken as 100, the index for maintenance expenditures fell to 44.3 in 1933 and recovered to 63.6 in 1937.[21] In actual money terms, maintenance expenditures declined from over 2 billion dollars in 1929 to less than a billion dollars in 1932 and 1933; they made some recovery in 1937, reaching 1.3 billion dollars.

Maintenance expenditures decreased more in the depression than revenue ton-miles as shown in Chart 2. From 1929 to 1933 such expenditures dropped

CHART 2



55%, while traffic in terms of revenue ton-miles shrank by only 48% from 1929 to its 1932 low.[22] Moreover, traffic resumed the upswing one year before these expenditures turned up again. Roughly the course of both series is similar, for the decline in railway services meant a reduction in the need for railroad maintenance at about the same rate. The fact that maintenance expenditures declined more rapidly than traffic is explained by practices which Commissioner Splawn of the Interstate Commerce Commission has called "continued skimping." [23] In the upswing beginning in 1934, maintenance expenditures on the roads were not expanded at the same rate as traffic represented by ton-miles. In 1937 traffic was some 20% below the 1929 level, while these expenditures were 35% lower.

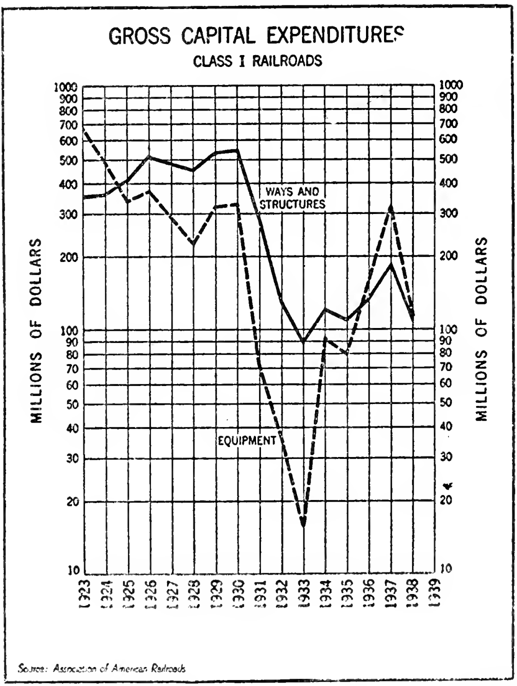
[21] See Appendix, Table 14.
[22] *Ibid.*
[23] Quoted in the *Report of the Emergency Board to the President,* (1938), p. 12.

The Interstate Commerce Commission in the *Fifteen Percent Case*, 1937–1938, summarized the evidence on maintenance as follows:

"During the period of recovery in railroad traffic and earnings since 1932, maintenance continued to be governed mainly by immediate needs dependent on volume of traffic. A year or so ago, when the outlook seemed more encouraging, a number of roads expanded their maintenance programs, but curtailed them again sharply in latter part of 1937, when operating costs increased and traffic declined. The cumulative burden of deferred maintenance dating from the depression therefore is still present. * * * Deferred maintenance of structures appears to be particularly extensive."[24]

2. *Capital Expenditures.*—The decline in the demand for railroad services affected gross capital expenditures far more drastically than expenditures for

CHART 3



maintenance (Chart 2—See Table 4 and Appendix, Table 8). Capital expenditures shrank from an average of 843 million dollars in the eight-year period 1923–1930 to only 259 million dollars in the 1931–1938 period, a decline of nearly 70%. These expenditures fell from 873 million dollars in 1930 to 362 million in 1931, a drop of almost 60% in one year.

The capital outlays for new equipment exhibited greater fluctuations than those for way and structures, as shown in Chart 3. Expenditures for capital equipment

[24] *Fifteen Percent Case* (*Ex Parte 123*, I. C. C. 226, 41, 63). As a result of these sharp curtailments in maintenance, there has been considerable undermaintenance on the railroads in terms of past performances. In a questionnaire analysis last year the Interstate Commerce Commission found that "at the close of 1938 there was deferred maintenance on the railway properties amounting to $238 million assuming a traffic as large as that of 1937 to be in prospect." Cf. I. C. C., *Financial Requirements of Railways*, Statement No. 3911, March 1939.

amounted to some 300 million dollars annually during 1926 to 1930.[25] In 1932 they were not much more than 10% of that amount; in 1933 they were 95% below their 1929 level.[26] They recovered to the 1929 volume in 1937 as a result of the needs of the increased traffic, which forced railroads to make up in part for their previous curtailment in expenditures of this type.

Reductions in capital expenditures for roadway and structures were relatively moderate when compared with those for new equipment. Even these reductions, however, were startling in their absolute magnitude; expenditures fell from approximately 500 million dollars in the predepression period to about 100 million in the years of deepest depression. The rise in 1937 to less than 200 million dollars was likewise much less spectacular than the corresponding change in capital expenditures for equipment.

The difference in behavior of the two classes of capital expenditures is explained by the difference in the means of adjustment to reduced demand for railroad services. But utilizing idle stocks of cars, railroads were able to eliminate almost completely their expenditures for new cars. When traffic increased as was the case in 1936–7 and the idle stock was depleted, it became necessary to buy large quantities of capital equipment.[27] On the other hand, it was necessary throughout the depression to make continuous use of the entire roadway and structures, and expenditures for such facilities could not be curtailed as drastically as expenditures for rolling equipment.[28]

B. STEEL CONSUMPTION BY THE RAILROADS

The drastic reductions in expenditures for maintenance and capital equipment by the railroads involved curtailment of the industry's consumption of steel (Chart 4—See tables 4 and 5). The available statistics do not allow a clean-cut division between maintenance and capital expenditures for steel, but the following table on iron and steel consumption shows the general trend and the fluctuations in the railroads' total consumption of finished steel and also in the railroads' "direct" purchases of iron and steel products.[29]

TABLE 5.—*Iron and Steel Consumption by Railroads, 1923–1938*

Year	Iron and Steel Products Purchased [1] (millions of dollars)	Iron and Steel Products as Percent of Total Railroad Purchases of Fuel Materials and Supplies [1]	Estimated Consumption of Hot-Rolled Iron and Steel Products [2] (thousands of gross tons)
1923	$465.0	26.7%	8,424
1924	365.6	27.2	7,196
1925	419.3	30.1	7,809
1926	507.3	32.5	7,656
1927	432.6	31.0	6,232
1928	397.5	31.3	6,119
1929	437.8	32.9	7,288
1930	329.7	31.7	4,679
1931	202.1	29.1	2,710
1932	100.6	22.6	1,050
1933	110.7	23.8	1,317
1934	159.8	26.6	2,271
1935	156.9	26.5	1,751
1936	273.8	34.1	3,645
1937	359.4	37.2	4,184
1938	152.2	26.1	1,289

Sources:

[1] Data for years 1923 to 1929 and 1933 to 1938 from Association of American Railroads, Bureau of Railway Economics. *A Review of Railway Operations.* Data for 1930 to 1932 from "*Railway Age.*" These figures cover "direct" purchases only and are not comparable with the tonnage figures in the last column.

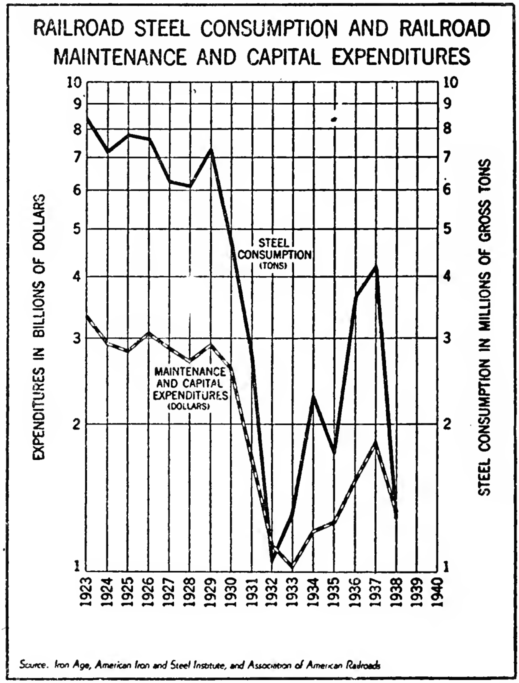
[2] Computed by apportioning individual hot-rolled product totals on the basis of *Iron Age* distribution reports and by allocating jobber shipments to ultimate consumers. See M. W. Worthing, *Distribution of Steel Products to Major Consuming Industries*, United States Steel Corporation, October 30, 1939.

[25] See Table 4 in text.
[26] See Table 4 in text.
[27] See Appendix, Table 15.
[28] See Appendix, Table 16.
[29] "Direct" purchases only cover purchases made directly by the roads and do not include the value of material and supplies purchased indirectly for the railways by contractors who carry on construction work, build equipment and do other work for the railways.

Like railroad revenues, dollar purchases of iron and steel products reached their peak in 1926, fell to a post-war low in 1932 when purchases were 77% below 1929, and recovered in 1937 to the level of 1930. Even then, they were still 30% below the 1926 peak. For the five years beginning with 1926, purchases averaged 421 million dollars, and for the five years 1931–5 they averaged only 146 million dollars, a decline of 65%. In tonnage terms, the railroad consumption of steel amounted to 7800 thousand gross tons in 1925, fell 87% to a low in 1932, and recovered to approximately 50% of the 1925 level in 1936 and 1937.

The "direct" purchases of iron and steel products decreased more rapidly in the depression years, 1931 to 1933, and increased more rapidly from 1934 to 1937

CHART 4



than total purchases of fuel, materials and supplies. These differences in rate of fluctuation are partly attributable to the fact that these iron and steel products are durable goods and their purchases can be more easily postponed than such items as fuel, which must bear a direct relation to traffic. The Interstate Commerce Commission found that, in part as a result of such deferability, one-fourth of the total undermaintenance in 1938 consisted in lack of rail renewals.[30] Full renewals could have meant increased expenditures on rails of 43 million dollars, if there were a return to the 1937 traffic, which was still approximately 20% below the traffic level of 1929.[31]

[30] Expenditures on heavier rails reached a peak of $47.2 million in 1928, fell 75% to a depression low of $12.0 million in 1932 and recovered to $31.8 million in 1936. In general, rail purchases from 1923 to 1930 averaged $40.0 million per year but fell 40% to an average of $23.1 million from 1931 through 1937 (Report of the Carriers to the Bureau of Railway Economics).

[31] Cf. I. C. C., *Financial Requirements of Railways*, Statement No. 3911, (March, 1939).

C. THE INFLUENCE OF THE PRICE OF STEEL ON ITS CONSUMPTION BY THE RAILROAD INDUSTRY

It has been shown that fluctuations in steel consumption are closely related to the volume of railroad services, to business fluctuations and to the financial condition of the railroads. In a setting of these basic factors, what role can the price of steel play in its consumption by the railroads?

Some understanding of the effect of changes in the price of steel on the railroads' consumption of steel can be had from Table 6 and Charts 5 and 6. Table 6 shows railroad expenditures for equipment and ways and structures in terms of 1929 dollars. The figures in this table were computed by dividing the actual expenditures given in Table 4 by the appropriate railroad price indices for equipment and road construction.[32] This result is a quantity index which shows physical volume of investments measured in terms of 1929 dollars, rather than the sums of money expended from year to year. If there were marked influences of steel prices on the quantity of steel included in the total physical volume of investment and therefore on total investment, rising quantities of total investments would tend to be associated with decreasing steel prices.

TABLE 6.—*Railroad Expenditures at 1929 Prices, 1923–1935*

[Millions of 1929 dollars]

Year	Equipment Expenditures			Ways and Structure Expenditures			Total Maintenance Expenditures	Total Capital Expenditures	Grand Total
	Maintenance	Capital	Total	Maintenance	Capital	Total			
1923	$1,376	$640	$2,016	$761	$353	$1,114	$2,137	$993	$3,130
1924	1,288	505	1,793	742	357	1,099	2,030	862	2,892
1925	1,355	364	1,719	787	395	1,182	2,142	759	2,901
1926	1,372	398	1,770	835	494	1,329	2,207	892	3,099
1927	1,239	293	1,532	847	471	1,318	2,086	764	2,850
1928	1,248	240	1,488	833	450	1,283	2,081	690	2,771
1929	1,203	321	1,524	855	532	1,387	2,058	853	2,911
1930	1,024	330	1,354	743	573	1,316	1,767	903	2,670
1931	894	80	974	594	323	917	1,488	403	1,891
1932	752	44	796	429	160	589	1,181	204	1,385
1933	727	19	746	406	112	518	1,133	131	1,264
1934	702	101	803	446	147	593	1,148	248	1,396
1935	704	82	786	481	133	614	1,185	215	1,400

Source: Derived from Table 4 in text and from price indexes in S. Fabricant, *Capital Consumption and Adjustment*, National Bureau of Economic Research, 1938, pp. 178–179.

Chart 5 compares percentage changes in composite steel prices with percentage changes in various types of physical investments of railroads. In Chart 5d the physical volume arising from maintenance expenditures is evidently without any gross relation to price changes. In the case of total volume of physical investments, rising prices, as shown in Chart 5a are associated with slightly rising volumes. The same is true for the other two components, the volume of total way and structure expenditures (Chart 5c) and total equipment expenditures (Chart 5b). Chart 5e shows unmistakably, with respect to the physical volume of capital expenditures, that the more steel prices rose, in comparison to the preceding period, the greater increases there were in the physical investment of the railroads, and thus in the quantity of steel consumed by the railroads. If anything, these charts show, as a whole, that decreasing steel prices have not been associated historically with rising quantities of physical investments.[33]

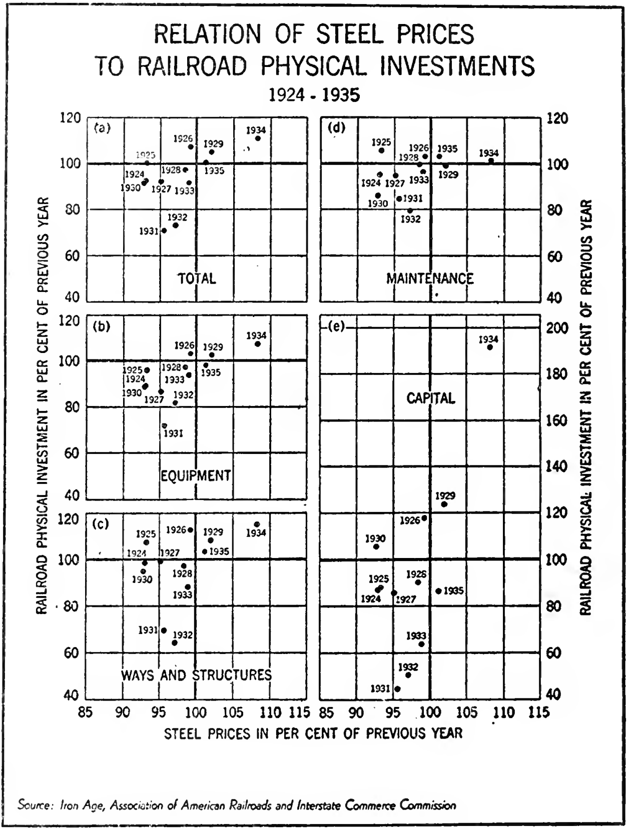
A more direct analysis of the relation between steel prices and steel consumption by the railroads is shown in Chart 6 (based on Table 5 and Appendix Table 17). This chart compares annual changes in steel consumption by the railroads with changes in the composite steel price, which was used in the absence of an accurate average price per ton for railroad steel.[34] If the annual purchases of steel by the railroads were primarily influenced by changes in steel prices, a general correlation between greater purchases and lowered prices should be evidenced. Chart 6

[32] Taken from S. Fabricant, *Capital Consumption and Adjustment*, National Bureau of Economic Research 1938, pp. 178–179.
[33] See appendix, Table 17.
[34] It should be noted that the data with respect to railroad steel consumption are subject to some inaccuracies, and that the changes in the average price per ton of railroad steel may differ somewhat from the changes in the composite steel price.

fails to show such a relationship and warrants the inference that other factors of much greater importance than price influence the quantities of railroad steel purchases.

The foregoing analysis supports the view that price considerations play rather subordinate roles among the factors which determine the volume of steel purchases in the railroad industry, as well as total steel consumption by the railroads. Steel

CHART 5

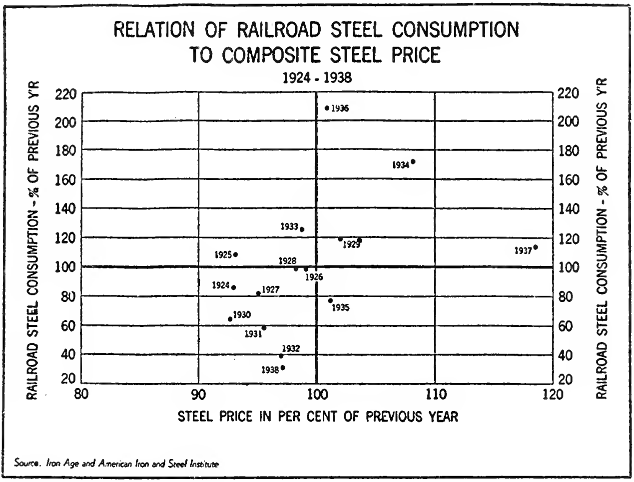


for maintenance is dependent to a high degree upon technical factors and to that extent the volume of traffic dictates quantities required. Capital expenditures for steel, on the other hand, appear to be dominated by such factors as availability of sufficient funds and the necessity of making replacements and improvements which were postponed during the depression. When necessitated by increased demand for transportation, capital expenditures are likely to be made at a rapid rate. Thus, general business conditions seem to determine the timing and extent

of those expenditures, which rise rapidly in a boom in spite of rising steel prices and shrink during the depression to an unimportant fraction of their former level irrespective of steel price decreases.

The comparative ineffectiveness of a reduction in steel prices to increase the consumption of railroad steel can be further demonstrated by a comparison of the total cost of steel purchases with total railroad revenues. Ultimately the cost of steel purchases is reflected in the cost to the consumer of railroad services. A comparison of railroad revenues (here assumed to represent the cost to the consumer of railroad services) with estimated total expenditures for railroad steel, during the period from 1923 to 1938 [35] shows that for the sixteen-year period expenditures for steel averaged about 5% of railroad revenues. If a reduction of 10% were made in the price of railroad steel and if this reduction were passed on in the form of a rate reduction, it would constitute a reduction of approximately one-half of one per cent in the cost to the consumer of railroad services. As shown elsewhere herein, the increase in the volume of railroad services as a result of rate reduction is low. (The elasticity of demand in the case of passenger

CHART 6



traffic was found to be approximately one half.[36]). Hence a 10% reduction in steel prices, if passed on to the consumer of railroad services, would serve to increase the total services rendered by railroads only slightly and to increase the steel consumed by the railroads probably by less than 1%. In addition, transporation rates are more or less inflexible due to the institutional method by which they are set up, and any changes in the cost of steel purchases, which is a small part of total railroad costs, could hardly be expected to be passed on in the form of lower rates in the short run.

The inability of steel producers to increase railroad consumption of steel substantially by a price reduction is apparent; and consequently, reductions in steel prices by themselves could be expected to have little effect on railroad rates, on total volume of railroad services, and on total steel consumption by the railroads.

[35] The average computed here is only a rough approximation, for there are definite limitations in the steel expenditures data used. The figures were computed by multiplying estimates of railroad steel consumption (which are subject to some inaccuracies) by the composite steel price index in lieu of an average price per ton for railroad steel. Even if the average price of railroad steel were slightly in excess of the composite steel price index, it would not, however, materially change the results.

[36] See: *Supra*, p. 6, and National Resources Committee, *op. cit.*, pp. 90, 91 and 99.

VI. Summary

Steel costs form only a small proportion of the total costs of transportation, and a change in steel prices could have practically no effect in increasing rail transportation by reducing its cost to the ultimate consumer. Consumers' income, industrial production and competition from other transportation media have been the important factors influencing the volume of railroad services and the consequent consumption of steel by the railroads. The demand for steel by the railroads is inelastic; a given percentage price reduction will not induce as large a percentage increase in the consumption of steel. The low consumption of steel by the railway industry in the last decade has been due to the declining trend in the demand for rail transportation, to the severe depression in business, and to the financial difficulties arising therefrom. No conceivable reduction in steel prices could have significantly altered the conditions arising from these forces.

Appendix

Table 7.—*Estimated Consumption of Hot-Rolled Steel by the Railroads, 1923-1938*

Year	Consumption (thousands of gross tons)	Percent of Total Consumption by All Industries	Year	Consumption (thousands of gross tons)	Percent of Total Consumption by All Industries
1923	8,424	25.3%	1931	2,710	14.1%
1924	7,196	25.6	1932	1,050	10.0
1925	7,809	23.4	1933	1,317	7.9
1926	7,656	21.6	1934	2,271	12.0
1927	6,232	19.0	1935	1,751	7.3
1928	6,119	16.3	1936	3,645	10.8
1929	7,288	17.7	1937	4,184	11.4
1930	4,679	15.9	1938	289	6.1

Source: Computed by apportioning individual hot-rolled product totals on the basis of *Iron Age* distribution reports and by allocating jobber shipments to ultimate consumers. See M. W. Worthing, *Distribution of Steel Products to Major Consuming Industries*, United States Steel Corporation, October 30, 1939.

Table 8.—*Freight Traffic, 1921-1938*

Year	Revenue Ton-Miles		Year	Revenue Ton-Miles	
	All roads (millions)	Class I roads (millions)		All roads (millions)	Class I roads (millions)
1921	309,533	306,840	1930	385,815	383,450
1922	342,188	339,285	1931	311,073	309,225
1923	416,256	412,727	1932	235,309	233,977
1924	391,945	388,415	1933	250,651	249,223
1925	417,418	413,814	1934	270,292	268,711
1926	447,444	443,746	1935	283,637	282,037
1927	432,014	428,737	1936	341,182	339,246
1928	436,087	432,915	1937	362,815	360,620
1929	450,189	447,322	1938	[1] 313,109	290,154

[1] Year ended June 30, 1938. Other figures are for the calendar year.

Source: From Reports of Interstate Commerce Commission.

TABLE 9.—*Indexes of Industrial Production and Freight Car Loadings, 1921-1938, Monthly Averages (1923-1925=100)*

Year	Industrial Production [1]	Freight Car Loadings [2]		Year	Industrial Production [1]	Freight Car Loadings [2]	
		Miscellaneous	Merchandise (l. c. l.)			Miscellaneous	Merchandise (l. c. l.)
1921	67	72	87	1930	96	99	97
1922	85	84	94	1931	81	78	87
1923	101	97	96	1932	64	55	72
1924	95	97	99	1933	76	58	67
1925	104	106	105	1934	79	64	65
1926	108	109	105	1935	90	69	64
1927	106	108	105	1936	105	82	66
1928	111	111	104	1937	110	86	67
1929	119	115	105	1938	86	67	61

Sources: Monthly data of these figures (as used in Chart 1) are found in Reports of the Division of Research and Statistics of the Board of Governors of the Federal Reserve Board.

[1] Released by Board of Governors of the Federal Reserve System, Division of Research and Statistics.
[2] *Federal Reserve Bulletin*, June, 1937, pp. 524–527, and current numbers.

TABLE 10.—*Passenger Miles, Consumers' Income, and Population, 1920-1937*

Year	Revenue Passenger Miles (billions)	Consumers' Income		Midyear Estimates of Population (millions)
		(Billions of current dollars)	(Billions of 1936 dollars)	
1920	46.8	$66.8	$47.0	106.5
1921	37.3	53.9	42.3	108.2
1922	35.5	57.9	48.8	109.9
1923	38.[illegible]	66.5	54.8	111.5
1924	36.1	67.3	55.4	113.2
1925	35.9	70.9	57.0	114.9
1926	35.5	73.3	58.3	116.5
1927	33.6	73.2	58.9	118.2
1928	31.6	75.8	62.2	119.9
1929	31.1	79.3	65.3	121.5
1930	26.8	71.9	60.4	123.1
1931	21.9	59.4	54.6	124.1
1932	17.0	45.9	46.7	125.0
1933	16.3	44.6	48.2	125.8
1934	18.0	51.8	54.0	126.6
1935	18.5	55.9	56.9	127.5
1936	22.4	63.9	63.9	128.3
1937	24.7	70.0	68.0	129.3

Source: Report of Industial Committee to National Resources Committee, *Patterns of Resource Use* (1939).

TABLE 11.—*Registrations of Passenger Automobiles, 1921–1938*

Year	Number (thousands omitted)	Index (1921=100)	Year	Number (thousands omitted)	Index (1921=100)
1921	9346	100.0	1930	23059	246.7
1922	10863	116.2	1931	22366	239.3
1923	13480	144.2	1932	20886	223.5
1924	15461	165.4	1933	20644	220.9
1925	17496	187.2	1934	21532	230.4
1926	19237	205.8	1935	22563	241.4
1927	20219	216.3	1936	24178	258.7
1928	21379	228.8	1937	25450	272.3
1929	23122	247.4	1938	25262	270.3

Source: Automobile Facts and Figures, 1939, p. 16.

TABLE 12.—*Total Operating Revenues, Total Operating Expenses, Taxes, and Net Railway Operating Income, 1921–1938 (Class I Railroads)*

Year	Total Operating Revenues (thousands of dollars)	Total Operating expenses		Taxes		Net Railway Operating Income	
		Amount (thousands of dollars)	% of total revenues	Amount (thousands of dollars)	% of total revenues	Amount (thousands of dollars)	% of total revenues
1921	$5,516,598	$4,562,668	82.71%	$275,876	5 0%	$600,937	10.9%
1922	5,559,093	4,414,522	79.41	301,035	5.4	760,187	13.7
1923	6,289,580	4,895,167	77.83	331,915	5.3	961,955	15 3
1924	5,921,496	4,507,885	76.13	340,337	5.7	973,937	16.4
1925	6,122,510	4,536,880	74.10	358,516	5.9	1,121,076	18.3
1926	6,382,940	4,669,337	73.15	388,923	6.1	1,213,090	19.0
1927	6,136,300	4,574,178	74.54	376,110	6.1	1,067,985	17.4
1928	6,111,736	4,427,995	72.45	389,432	6.4	1,172,864	19.2
1929	6,279,521	4,506,056	71.76	396,683	6.3	1,251,698	19.9
1930	5,281,197	3,930,929	74.43	348,554	6.6	868,879	16.5
1931	4,188,343	3,223,575	76.97	303,528	7.2	525,628	12.5
1932	3,126,760	2,403,445	76.87	275,135	8.8	326,398	10.4
1933	3,095,404	2,249,232	72.66	249,623	8.1	474,296	15.3
1934	3,271,567	2,441,823	74.64	239,625	7.3	462,652	14.1
1935	3,451,929	2,592,741	75.11	236,945	6.9	499,819	14.5
1936	4,052,734	2,931,425	72.33	319,753	7.9	667,347	16.5
1937	4,166,069	3,119,065	74.87	325,665	7.8	590,204	14.2
1938 [1]	3,565,000	2,722,000	76.35	341,000	9.6	372,846	10.5

Sources: *Report of Committee Appointed September 20, 1938 by the President of the United States to Submit Recommendations Upon the General Transportation Situation (1938)*, Table 12, p. 78. Based on Reports of Interstate Commerce Commission.

[1] 1938 figures from Association of American Railroads, Bureau of Railway Economics, *A Review of Railway Operations in 1938.*

TABLE 13.—*Average Hourly Earnings, Average Dividend Rates on Capital Stock Outstanding, and Interest on Debt, 1929–1937 (Class I Railroads)*

Year	Average Hourly Earnings [1] (cents)	Average Dividend Rates [2] (percent)	Interest on Debt [3] (millions of dollars)
1929	66.6¢	5.99%	511
1930	67.8	6.01	509
1931	68.9	3.99	518
1932	63.6	1.12	525
1933	62.9	1.16	524
1934	63.5	1.62	511
1935	68.6	1.54	509
1936	69.1	2.11	494
1937	70.9	2.07	491

Sources:

[1] Committee of Public Relations of the Eastern Railroads, *A Yearbook of Railroad Information* (1935 and 1938 editions), p. 62.

[2] Quoted in *Report of the Emergency Board to the President*, (1938), p. 9. The capital stock outstanding includes stock of railroads in trusteeship or receivership. Also based on data from *Statistics of Railways in the United States*, Interstate Commerce Commerce, 1937.

[3] Committee of Public Relations of the Eastern Railroads, *op. cit.*, p. 38.

TABLE 14.—*Maintenance Expenditures and Revenue Ton-Miles, 1921–1938 (Class I Railroads)*

Year	Maintenance Expenditures		Ton-Miles of Revenue Freight (millions)	Year	Maintenance Expenditures		Ton-Miles of Revenue Freight (millions)
	(millions of dollars)	Index Average 1921–1928=100			(millions of dollars)	Index Average 1921–1928=100	
1921	$2,008	96.5	306,840	1930	1,725	82.9	383,450
1922	1,981	95.3	339,285	1931	1,348	64.8	309,225
1923	2,279	109.6	412,727	1932	970	46.6	233,977
1924	2,053	98.7	388,415	1933	921	44.3	249,223
1925	2,076	99.8	413,814	1934	1,003	48.2	268,711
1926	2,150	103.4	443,746	1935	1,076	51.7	282,037
1927	2,088	100.4	428,737	1936	1,238	59.5	339,246
1928	2,005	96.4	432,915	1937	1,322	63.6	360,620
1929	2,058	99.0	447,322	1938	1,097	52.8	290,154

Source: Association of American Railroads, Bureau of Railway Economics. *A Review of Railway Operations in 1938* (p. 20), and Interstate Commerce Commission, *Statistics of Railways in the United States*

TABLE 15.—*Railroad Equipment Expenditures, Available Freight Cars, and Carloadings, 1921–1938*

Year	Average Freight Cars Owned (thousands)	Average Serviceable Cars (thousands)	Surplus Cars Lowest Reported (thousands)	Carloadings Highest Week (thousands)	Equipment Expenditure (millions of dollars)
1921	2,317	2,008	80	965	311
1922	2,304	1,993	4	1,000	246
1923	2,303	2,113	14	1,098	682
1924	2,331	2,146	99	1,113	494
1925	2,355	2,168	112	1,124	338
1926	2,345	2,190	81	1,209	372
1927	2,329	2,191	135	1,129	289
1928	2,298	2,154	104	1,197	224
1929	2,267	2,132	119	1,202	321
1930	2,270	2,128	393	985	328
1931	2,229	2,053	535	775	73
1932	2,160	1,922	545	651	36
1933	2,072	1,779	380	687	15
1934	1,969	1,674	318	646	92
1935	1,863	1,584	208	734	79
1936	1,770	1,526	112	826	159
1937	1,723	1,543	104	847	323
1938	1,713	1,496	139	726	115

Source: Taken from testimony of Dr. Lauchlin Currie before the Temporary National Economic Committee on May 16, 1939, Volume 3, Table IV, p. 357. For notes and methods see Dr. Currie's appendix.

TABLE 16.—*Freight and Passenger Miles, Mileage Operated, Equipment in Service, and Installation of Equipment and Rails of Class I Railways, 1926–1937*

Year	Freight Tons Carried One Mile [1] (millions)	Passengers Carried One Mile (millions)	Mileage Operated, End Of Year (thousands of miles)	Equipment in Service, End of Year			Rails Laid in Replacement (thousands of gross tons)			New Equipment Installed [3]		
				Locomotives [2] (thousands)	Freight train cars (thousands)	Passenger train cars (thousands)	Total	New	Second-hand	Locomotives	Freight train cars	Passenger train cars
1926	486	35.5	394.9	62.8	2,349	54.8	3,818	2,210	1,608	-----	-----	-----
1927	472	33.6	399.2	61.4	2,325	53.8	3,819	2,125	1,690	-----	-----	-----
1928	474	31.6	403.5	59.5	2,298	53.1	3,806	2,080	1,725	-----	-----	-----
1929	490	31.1	406.5	57.5	2,277	52.3	3,610	1,958	1,652	-----	-----	-----
1930	420	26.8	408.0	56.5	2,277	52.1	2,764	1,517	1,157	-----	-----	-----
1931	338	21.9	408.2	55.1	2,201	50.7	1,715	985	730	-----	-----	-----
1932	257	17.0	407.1	53.2	2,145	49.4	798	395	403	90	2,815	58
1933	273	16.3	404.9	50.8	2,035	46.5	862	403	459	14	1,936	7
1934	296	18.0	402.4	48.2	1,938	43.8	1,165	631	534	90	23,948	270
1935	310	18.5	400.3	46.5	1,836	41.6	1,159	583	576	139	6,987	225
1936	372	22.4	397.8	45.0	1,758	40.6	1,701	921	780	98	37,554	159
1937	395	24.7	395.6	44.4	1,744	40.3	1,975	1,030	945	441	69,118	576

Source: Interstate Commerce Commission, *Statistics of Railways*, 1937, and earlier volumes.

[1] Total of revenue and non-revenue ton miles.
[2] Total of steam and electric locomotives.
[3] Data prior to 1932 not available. Data for domestic shipments of locomotives (U. S. Bureau of the Census) and freight and passenger cars (American Railway Car Institute) indicate the following changes between 1929 and 1937; locomotives, −36.5%, freight train cars, −10.9%, and passenger train cars, −57.6%. See: *Survey of Current Business*, 1938 Supplement, p. 162.

TABLE 17.—*Composite Price of Finished Steel, 1923–1938*

Year	Composite Steel Price (cents per pound)	Year	Composite Steel Price (cents per pound)
1923	2.697	1931	1.957
1924	2.505	1932	1.901
1925	2.334	1933	1.879
1926	2.315	1934	2.033
1927	2.202	1935	2.058
1928	2.165	1936	2.077
1929	2.209	1937	2.464
1930	2.048	1938	2.394

Source: *Iron Age* (January 5, 1939), p. 198.

EXHIBIT NO. 1415

AN ANALYSIS OF THE DEMAND FOR STEEL IN THE CONTAINER INDUSTRY

This is an analysis prepared by the Special Economic Research Section of United States Steel Corporation, composed of Messrs. Edward T. Dickinson, Jr., Ernest M. Doblin, H. Gregg Lewis, Jacob L. Mosak, Mandal R. Segal, Dwight B. Yntema and Miss Marion W. Worthing. The work of this group was under the supervision of Theodore O. Yntema, Professor of Statistics, University of Chicago. This analysis was written by Mandal R. Segal who had the benefit of suggestions from other members of the staff. It is issued by United States Steel Corporation.

NOVEMBER 1, 1939.

CONTENTS

I. Purpose

The purpose of this study is to analyze the factors determining the quantity of steel consumed by the container industry [1] (of which tin can manufacture is the greater part) and particularly to determine the importance of price as a factor in this consumption.

Steel (mainly in the form of tin plate) is the principal raw material in the production of tin cans, which are used mainly to pack consumers' goods, such as food, oil, beer, and paints and varnishes. Thus, the consumption of steel by the tin container industry depends upon:

(1) The output and consumption of all "canned" goods, i. e., all goods that are put in containers;

(2) The proportion of this output that is put in tin cans and not in containers made of other materials; and

(3) The amount of steel used in the individual container.

A change in the price of steel can affect steel consumption by the tin container manufacturing industry only in so far as it affects these three factors.

II. Findings

(1) The demand for products packed in tin cans is dependent primarily upon consumer income.

(2) There has been an upward trend in tin can consumption, which is explained by the increasing use of tin cans to pack new food and other products. This adaptation of tin cans to additional uses in the past ten years has also contributed to the relative cyclical stability of tin can consumption.

(3) Public tastes and preferences have been among the most important factors limiting the substitution of tin cans for other containers. The physical and chemical characteristics of the products to be packed have also tended to restrict substitution and adaptation of tin cans to new uses. Existing equipment and distribution facilities constitute another deterrent to substitution.

(4) Other investigations have shown that the demand for food is generally inelastic. The available data also indicate that fluctuations in the total consumption of canned food products have had little net relation to fluctuations in canned food prices or to fluctuations in the ratio of canned food prices to other food prices. From these facts it seems reasonable to infer that the demand for canned food has a low elasticity.

(5) The price of tin plate is about one-tenth of the retail price of representative food products packed in tin containers and is probably less than one-tenth of the retail price of most products packed in general line cans. A 10 percent reduction in the price of tin plate, if entirely passed on to the consumer of the canned product, would therefore reduce the retail price of the canned product only about 1 percent. In the case of canned food products, this would result in a saving to the consumer of only a small fraction of one cent per can. Consequently, any reduction in the price of tin plate, even if the consumer of the canned commodity received the full benefit of such price reduction, could affect the final price of the canned commodity only slightly and could have no appreciable effect on the consumption of canned goods.

(6) In the past there has been no discernible relation between the consumption of representative individual canned food products and the price of tin plate. This simply reflects the major importance of other factors and the very minor importance of the price of tin plate in determining the consumption of canned foods.

(7) Physical and chemical requirements of the products to be packed determine almost entirely the weight, composition and amount of the steel used in tin containers.

These findings show that tin plate prices have only a negligible effect on the immediate factors determining steel consumption by the container industry, namely:

(a) the output and consumption of all "canned" goods;

(b) the proportion of this output that is put in tin cans and not in other types of containers; and

(c) the amount of steel used in the individual container.

To sum up, the consumption of steel by the container industry is derived from and dependent upon the consumption of the products packed in tin containers. A change in the price of tin plate can increase its consumption only by

[1] Although the container industry might be defined as comprising all types of containers, including many made of materials other than steel, this study is limited to "light containers" made from light steel products, and is devoted primarily to tin cans, in the manufacture of which roughly three-quarters or more of the steel taken by the container industry is consumed.

the reduced cost being passed on to the ultimate consumer of the canned product and only to the extent that the consumption of canned products is increased thereby. Taking into account the low elasticity of demand for canned products, the limited degree of substitutability attributable to price, and the relative unimportance of the price of the tin container in the price of the packaged product, it is evident that the demand for tin plate is very inelastic. Fundamental factors such as consumers' income and public tastes determine the demand for canned commodities and, hence, the consumption of steel by the tin-can industry. The price of the steel consequently is of minor significance in determining this consumption.

III. The Container Industry

The demand for steel by the container industry is a derived demand, i. e., it is dependent upon the factors affecting the demand for containers. Consequently, any study of the container industry's demand for steel must first deal with the factors which have a bearing on the demand for products packed in tin containers.

The active growth of the canning industry in this country began in the period of the 1860's and 1870's; by the turn of the century canneries were started all over the country for fruits, vegetables, and fish.[2] Since then the tin container manufacturing industry has progressed rapidly. Whereas in 1904 this industry had a value of product of 41 million dollars, by 1937 the product totalled 350 million dollars. In the latter year more than 16 billion cans were manufactured and the "tin can and other tinware" industry paid out 37 million dollars in wages and 245 million dollars for materials, fuel, and purchased electric energy.[3] It has been estimated that approximately 100 cans per year are made in the United States for every person in the country.[4]

Tin plate is suitable for containers for a wide variety of products on account of its cheapness, strength, lightness, nontoxicity, pleasing and sanitary appearance, ease of fabrication, durability, bright reflective surface and suitability for coating and decorating by lithographing. The use of the tin can has therefore expanded in the food packing field and has been recently extended into new fields, such as motor oil, paints and varnishes, pharmaceutical and toilet articles, beer and tobacco.

In contrast to most other industries consuming steel, the tin can industry has maintained a comparative cyclical stability, with small fluctuations even in the depression period. This is due to the fact that canned goods are mostly perishable consumers' products, i. e., production is followed more or less immediately by consumption and the factor of durability is usually not involved since most cans are used only once.

A second characteristic of the tin can industry is the relatively steady upward trend in can production. Basically, this trend is caused by new and more diversified uses for tin cans. These, in turn, are associated with public tastes and preferences and technological advances in the steel and container industries.

The products of the can industry can be grouped under two heads:

(a) *Food or Packer cans*, which include most of the tin containers for foodstuffs, comprise approximately 55 percent of the total value of all products of the tin can industry. More than 11 billion of the 16 billion cans produced in 1937 were of this type.[5] In 1935 the packer, or food, cans[6] were distributed among products as follows: 57 percent were used for vegetables, soups, fruits and juices; 25 percent for evaporated milk; 15 percent for fish and meat; and the remaining 3 percent were used for food specialties and dry and sweetened milk.[7] Of the foods canned, there are many varieties, including 46 classes of canned vegetables, 33 classes of fruits, 10 classes of juices, 27 classes of fish and shellfish, 41 classes of specialites, 23 classes of meats, 37 classes of soups and 8 classes of ready-made entrees.[8]

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[2] National Canners Association, *The Canning Industry*, March 1, 1939.
[3] *Census of Manufactures*, 1937, "Tin Cans and Other Tinware", release October 12, 1938.
[4] International Tin Research and Development Council, *Tin Plate and Tin Cans in the United States* (1936), p. 6.
[5] See Appendix, Table 7.
[6] Although there are 27 different sizes of sealed cans used by commercial canners, in general the packers cans are standardized in size and shape.
[7] Evaporated Milk Association, *Some Facts About Evaporated Milk and Other Dairy Products*, p. 19.
[8] American Can Company, *The Canned Food Handbook*, pp. 14-16.

(b) *General line cans* totalled nearly 5 billion in number in 1937 and represented 45 percent of the value of the product of the tin can industry.[9] These general line cans are of innumerable sizes and shapes ranging from tiny pill boxes to large oil cans and are used for countless varieties of commodities which do not require heat treatment in the packaging process.[10] Among the most important products packed in general line cans are oil, beer, paints and varnishes, bulk milk (which is placed in large dairy milk cans), tobacco, toilet and pharmaceutical articles, and wax. It should be noted that beer, ice cream, dairy milk, and coffee cans are classed in this category of general line cans in spite of the fact that the products contained in such cans are food products.

IV. Steel Consumption by the Container Industry

The consumption of steel as a raw material in the manufacture of tin cans and other light containers has shown a substantial upward trend since 1923. In the period from 1923–1929 this industry consumed an annual average of 1.42 million gross tons of steel but in the period from 1932–1938 its consumption averaged 1.95 million gross tons, an increase of about 37 percent.[11] The industry's relative position as a steel consumer has also risen; in 1923 it took only 3.6 percent of the total finished rolled steel produced in this country, but since 1932 it has taken nearly 9 percent of the total output. In 1938 it ranked third among consuming industries, accounting for 9.1 percent of the total production of finished steel. The upward trend and increasing importance of the container industry as a consumer of steel can be seen from the following table:[12]

TABLE 1.—*Estimated Consumption of Steel by the Container Industry, 1923–1938*

Year	Consumption of Hot-Rolled Iron and Steel (thousands of gross tons)	Percent of Total Hot-Rolled Stee Production	Year	Consumption of Hot-Rolled Iron and Steel (thousands of gross tons)	Percent of Total Hot-Rolled Steel Production
1923	1,205	3.6%	1931	1,415	7.4%
1924	1,210	4.3	1932	1,037	9.9
1925	1,427	4.3	1933	1,759	10.5
1926	1,348	3.8	1934	1,557	8.2
1927	1,408	4.3	1935	2,039	8.5
1928	1,619	4.3	1936	2,455	7.3
1929	1,707	4.2	1937	2,874	7.8
1930	1,670	5.7	1938	1,908	9.1

Source: Computed by apportioning individual hot-rolled product totals on the basis of *Iron Age* distribution reports and by allocating jobber shipments to ultimate consumers. See M. W. Worthing, *The Distribution of Steel Products to Major Consuming Industries*, United States Steel Corporation, October 30, 1939.

At least 70 to 80 percent of the steel consumed by the container industry is used in the form of tin plate and terne plate in the manufacture of packer and general line cans. In the production of tin cans the most important raw material is tin plate which consists of about 98 percent steel and 2 percent tin.[13] The cost of tin plate represents approximately 60 percent of the value of the tin can.[14] Terne plate, while similar to tin plate, contains some lead and is primarily used, therefore, for non-food products such as lubricating oil.

Due to the relative stability and upward trend in the consumption of tin plate, mills engaged in its production were operating at from 60 to 90 percent of capacity during the depression while the steel industry as a whole was producing at from

[9] General line cans and packages include tin boxes and pails. In general the total value of product of packers and general line cans listed here was 335.0 million dollars, which was 93.4 percent of the total value listed for the tin can and other tinware industry. The remainder, i. e., 18.5 million dollars, represented finished tinware other than cans.

[10] Beer is an exception, requiring heat treatment.

[11] See Table 1 in text.

[12] The series of "Tin Plate and Terne Plate" taken from the *Census of Manufactures* shows a similar course. See Appendix, Table 9. Differences in the two tables are probably due to varying methods of computation and different coverage and classification.

[13] National Canners Association, *The Story of the Tin Can*, and American Can Company, *A Word about Tin Cans*, p. 1.

[14] See Appendix, Table 8.

15 to 60 percent of capacity.[15] The upward trend in the consumption of tin plate, most of which is used in the production of tin cans,[16] can be seen in the following table:

TABLE 2.—*Consumption of Tin Plate in the United States, 1923–1935*

Year	Total Consumption (thousands of gross tons)	Tin Plate Used for Packer Cans (Thousands of gross tons)	Tin Plate Used for Packer Cans (Percent of total)
1923	1,291	661	51%
1925	1,383	719	52
1927	1,348	702	52
1929	1,541	894	58
1931	1,293	715	55
1933	1,579	738	47
1935	1,560	925	59

Source: International Tin Research and Development Council, *Statistical Yearbook, 1939*, p. 134. These figures differ from the estimates given in Table 1 due to differences in coverage and construction.

V. Relation of Price to Demand for Tin Plate

Total consumption of steel by the container industry, most of which is in the form of tin plate, is compared with an index of the price of tin plate from 1923 to 1938 in Chart 1.[17] This chart shows the marked upward trend in consumption of steel by the container industry during this period. It is evident from the chart that the relatively large fluctuations in steel consumption must be due to influences other than changes in the price of tin plate.

In order to determine the relative importance of the influence of the price of tin plate on its consumption in a more detailed manner, the two major branches of the container industry, i. e., packer and general line cans, are analyzed to discover the extent to which the tin plate price affects:

(1) the output and consumption of all canned goods, i. e., all goods that are put in containers;
(2) the proportion of this output that is put in tin cans; and
(3) the amount of steel in the tin cans.

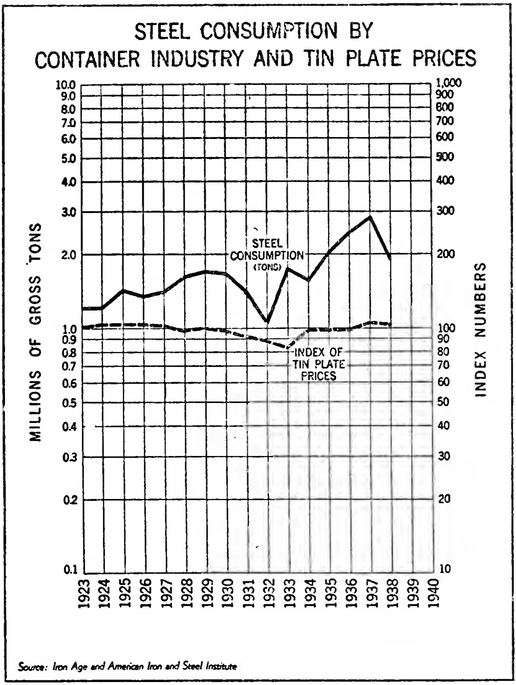
A. Demand for Food or Packer Cans

The relative stability in the production of food cans, which constitute 55 percent of the total value of all tin containers and consume approximately the same percentage of the total quantity of tin plate taken by the container industry, is due to the fact that food in general is a necessity. Food expenditures are the first and greatest expense item in the budget, representing approximately 35 percent of the expenditures of the middle income class [18] and higher proportions in the lower income groups.[19] While consumers' income declined 28.5 percent from 1929 to the low of 1932, food production fell only 10.3 percent. In the recovery through 1936, consumers' income rose 36.8 percent, while food production gained only 3.4 percent.[20] Thus, total food production has been remarkably stable, showing relatively less fluctuation than has consumers' income (Chart 2). The consumption of canned foods [21] has fluctuated in the cycle in close relation to consumers' income but with somewhat greater amplitude than total food production (Chart 2).

[15] International Tin Research and Development Council, Bulletin 4, *Tin Plate and Tin Cans in the United States*, 1936, p. 6.
[16] International Tin Research and Development Council, *Tin Plate and Tin Cans in the United States* (Bulletin 4, Oct., 1936), p. 77. In addition, see *Iron Age* (March 10, 1936), p. 58A.
[17] For supporting data, see Appendix, Table 10.
[18] Works Progress Administration, Division of Social Research, *Inter-city Differences in Cost of Living* (March, 1935) 59 cities.
[19] A recent survey by the United States Department of Labor found that: "Although food accounts for approximately two-fifths of the total expenditures of families at the bottom of the income scale, only one-fifth or less of the expense of families in the highest income level is accounted for by food." (United States Department of Labor, Bureau of Labor Statistics, *How Urban Families Spend Their Incomes*, Release, July 10, 1938.)
[20] See Appendix, Table 11.
[21] This close relationship between canned foods and consumers' incomes was recently borne out by several studies by the Division of Statistics of the National Canners Association. These studies found that the changes in employment and consumers' buying power are of great importance in determining both the prices and consumption of the leading canned vegetables: cf. National Canners Association, *Factors Affecting Production and Distribution of Canned Peas, Corn, Tomatoes, and Snap Beans, and also Canned Sweet Corn* (1937).

The relative importance of consumers' income in the determination of the consumption of canned foods is indicated in a study by the National Resources Committee reported in "Patterns of Resource Use."[22] There it is shown that 88 percent of the variation in the consumption of canned fruits and vegetables is explained by two factors, consumer income and a time trend. Furthermore, if the residual variation in consumption not accounted for by these factors is plotted against an index of canned food prices, or against the ratio of canned food prices to general food prices, no relationship is evident. Thus the price of canned foods appears not to have been an important factor in determining their consumption.[23]

CHART 1

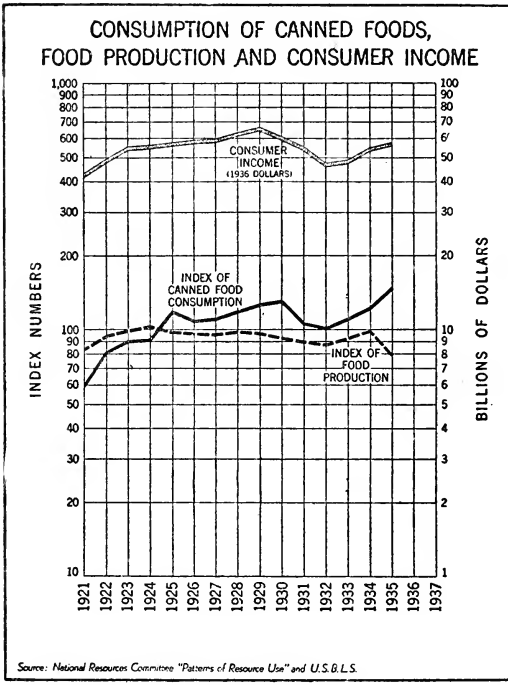


The role of the price of steel entering into the tin can in which food is packaged is even less important. It can only affect the consumption of canned products by affecting their price. But the cost of steel used in tin cans constitutes only a small part of the retail prices of the canned products. In an analysis of eleven leading canned vegetables and fruits, it was found that in only four cases was the cost of tin plate more than 10 percent of the final retail price of the product; in two cases, the cost of tin plate was less than 5 percent of the final price; while in the remaining five products, the cost of tin plate varied from 5 to 10 percent of the retail price. The following table lists the products, their retail prices, the

[22] *Op. cit.*, p. 103.

[23] The investigations by Henry Schultz, *Theory and Measurement of Demand*, Chicago, 1938, show that the demand for most agricultural products is inelastic.

CHART 2



stimated tin plate cost, and the estimated proportion that such tin plate cost orms of the total selling price.

TABLE 3.—*Tin Plate Costs in Relation to Retail Prices of Canned Goods, 1938*

Commodity	Retail Price [1] (cents)	Estimated Tin Plate Costs [2] (cents)	Tin Plate Cost as Proportion of Retail Price (percent)
1. Tomatoes—No. 2 standard	8.8¢	1.22¢	13.9%
2. Beans and Pork—No. 1	7.4	0.88	11.8
3. Green Beans—No. 2	11.2	1.22	10.9
4. Corn—No. 2 standard	11.6	1.22	10.5
5. Peas—No. 2 standard	15.1	1.22	8.1
6. Peaches—No. 2½ can	18.6	1.48	8.0
7. Pears—No. 2½ can	21.3	1.48	6.9
8. Pineapple—No. 2½ can	22.4	1.48	6.6
9. Pink Salmon—16 oz. can, tall	13.4	0.87	6.5
10. Asparagus—No. 2 can	29.5	1.22	4.1
11. Canned Sal on—16 oz. can, tall	25.7	0.87	3.4

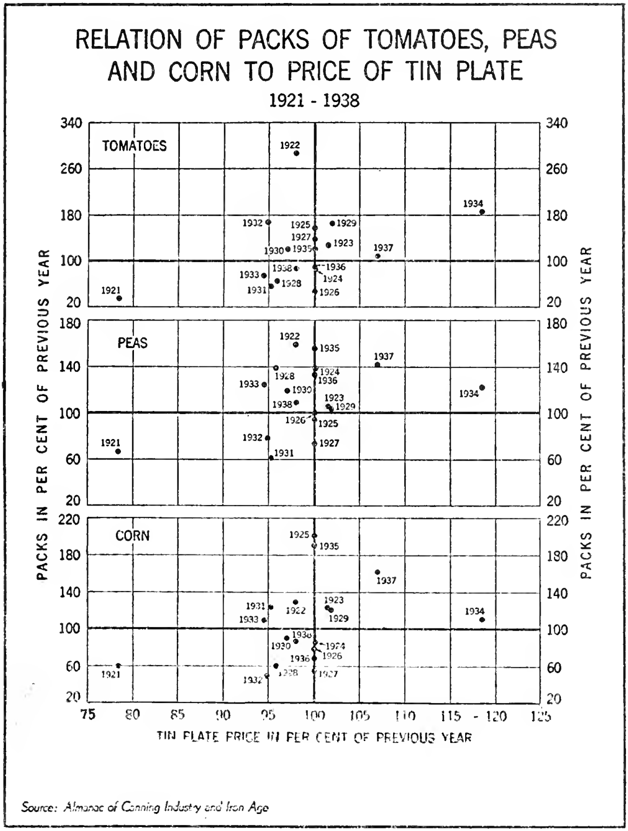
Sources:
[1] United States Bureau of Labor Statistics, Bulletin 635, *Indexes of Retail Price of Food in 51 Cities*, (1938).
[2] Calculated by assuming a 60 percent steel proportion (see *supra*, p. 6, and Appendix, Table 8) in the price of tin cans, which in 1938 were as follows:

No. 1 Tall can—16 oz	$14.56 per 1,000 cans
No. 2½ Can—1 lb. 13 oz	24.71 " " "
No. 2 Can—1 lb. 3 oz	20.32 " " "

Almanac of the Canning Industry, 1939, p. 236, published by *The Canning Trade*.

Any practical reduction in the price of tin plate, if fully reflected in the price of the canned food products, could reduce the final product price only slightly. Even a 10 percent reduction in the price of tin plate, if passed on to the consumer, would by itself lower the retail prices of most of these canned food products by less than 1 percent, or approximately one-tenth of one cent per can.

CHART 3



The relative unimportance of the price of tin plate, so far as consumption of of canned food products is concerned, is confirmed by Chart 3 where percentage changes in the production of canned tomatoes, peas and corn are compared with percentage changes in the price of tin plate.[24] Since changes in the production of these products have not been associated historically with changes in price of tin plate, they must have been due mainly to the influence of other factors.

[24] See also Appendix, Table 12.

To summarize: The cost of tin plate is a very small element in the price of canned foods and therefore changes in the price of tin plate can have but very slight effect on the price and consumption of canned foods.

There is still the question of the possible effect of the price of tin plate on the proportion of canned food output that is put in cans rather than in containers made of glass.[25] Among the factors important in determining this proportion are: (1) the relative prices of the different types of containers; (2) public taste, custom and convenience (as well as the possibility of changing these by advertising); (3) technical limitations on substitution; and (4) the existing bottling and canning equipment in the consumers' goods industries.

Although exact information on prices of the two types of containers is not available, a rough approximation based on the 1935 *Census of Manufactures* shows that the average price of glass containers of food products was slightly more than 2¢ a piece and the average price per food can was slightly less than 2¢.[26] These prices are, however, not strictly comparable, since they cover all types and sizes of food containers, many of which are not in direct competition,[27] and since they do not take into account the fact that the tin can is used only once whereas the glass container may be a semi-durable commodity used more than once. However, when the glass food container is not returned,[28] the total original cost must enter into the final product price of the glass-contained product just as the total initial cost of the tin can must enter into the selling price of the canned goods. Although in general the price of tin cans for food is slightly lower than the price of glass containers, there are more important factors determining the use of cans for most foods.

First of all, food products in cans have come to be accepted and even preferred because of certain advantages which this form of packaging possesses. Cans are not breakable; they are readily fabricated in desired sizes, weigh less, require less space, and are easier and cheaper to ship and handle than bottles or glass containers. Juices which "cloud up" do not lose their sales value in cans. It is not necessary to return the cans and no deposit or bookkeeping is involved.[29]

Habit and custom are important determinants of preferences for different types of containers. Most vegetables, fruits, evaporated milk and fruit juices have found acceptance in cans, while bottles are preferred for fresh milk and certain beverages. Of late there has been a growth in popularity of cans over bottles for the packaging of beverages and juices for consumption in the home; experiments are being carried on in the canning of ginger ale, coca-cola, and other liquids. On the other hand, bottles are being used to package certain high priced vegetables and fruits.[30] Thus, public taste and custom,[31] which are of major importance in determining the proportion of foods packaged in cans, tend to limit the substitution of cans for glass containers and vice versa in response to price changes.

The lines of competition among the various types of containers have also recently been extended by the use of frozen foods. In the past few years there has been a marked increase in the packaging of frozen fruits, which reached a total of 117.8 million pounds in 1938.[32] Part of the frozen food pack is packaged in cans of ordinary food sizes (No. 10 cans) and in larger tin containers (10–50 pound and 1–5 gallon cans), but the majority of the frozen foods is found in 1 pound cartons (cups and boxes). In general, however, these frozen foods have not cut into the sale of vegetables and fruits packed in tin containers, because (1) the frozen foods compete mainly with fresh foods, (2) they are higher priced than canned foods, (3) many homes are not equipped for storage, and (4) many vegetables and fruits have not yet been successfully frozen.

In addition to the public taste, the chemical and physical properties of foods give rise to technical limitations on the kinds of food put in tin cans.

Substitution of bottles for cans, or vice versa, is restricted by the costliness of such a shift. The change from the use of bottles to tin cans involves the cost of

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[25] While paper containers are useful for many purposes, they seem to compete more directly with glass than tin. In any event, competition with tin plate is greatest from glass and the discussion is confined primarily to that problem. Many of the same considerations, however, would apply to competition from other types of containers, including paper.

[26] *Census of Manufactures*, 1935, pp. 842 and 958.

[27] See *infra*, p. 15.

[28] Beverage and milk bottles are the exceptions here. Their original costs are approximately 2.4¢ and 3.6¢ respectively. Because it is refilled a number of times, the average cost per bottle is relatively low.

[29] For other advantages of the tin can, cf. Bulletin 4, of International Tin Research and Development Council, *Tin Plate and Tin Cans in the United States* (1936), pp. 8–9.

[30] *Western Canner and Packer, Yearbook and Statistical Number* (1939), p. 174.

[31] Some change in public taste may be effected by advertising campaigns, as was true in the case of the beer can. See *infra*, pp. 15–16.

[32] *Western Canner and Packer*, *op. cit.*, p. 190.

scrapping old bottling equipment and investing in new canning equipment. This change will be made only if large savings are realizable, or if consumers' preferences require the change.

B. DEMAND FOR GENERAL LINE CANS

Many consumers' products, such as oil, paints and varnishes, tobacco, chemicals, pharmaceutical and toilet articles, spices, beer, and coffee, are packaged in general line cans. As previously stated, this group of cans accounts for approximately 45 percent of the total quantity of tin plate taken by the tin can industry.

In analyzing the demand for general line cans, special attention will be devoted to beer, oil, and paint and varnish cans. These are the most important of the general line cans and illustrate the types of considerations covering the demand for such containers.

(1) *Beer Cans.*—Of the general line cans, beer cans are today among the most important. In 1937 more than 630 million beer cans were produced with a value of 14 million dollars or approximately 4 percent of the total value of all the tin cans and tin utensils produced in that year.[33] Since the sale of beer was re-legalized so recently, and beer cans have been in use for only the past four years, any analysis of the beer industry's consumption of tin cans necessarily must be tentative.

As shown in Table 4, beer consumption has had an upward trend since re-legalization in 1933; it also appears to respond to changes in consumers' income.

TABLE 4.—*Production of Fermented Malt Liquors, and Consumers' Income, 1934–1938*

Year	Production of Fermented Malt Liquors [1]		Consumers' Income [2]	
	Number of barrels	Index (1934=100)	Millions of dollars	Index (1934=100)
1934	37,678,313	100	52,057	100
1935	45,228,605	120	55,814	107
1936	51,812,062	138	64,207	123
1937	58,748,087	156	70,694	136
1938	56,340,163	150	65,021	125

Sources:
[1] United States Treasury Department, Bureau of Internal Revenue Alcohol Tax Unit, *Statistics on Fermented Malt Liquors and Cereal Beverages* (Fiscal year data).
[2] *Survey of Current Business*, June, 1939, p. 12.

With the increasing consumption of beer, there has been a shift to beer packaged in bottles and cans. Packaged beer rose from 20 percent of the total in 1933 to 45 percent in 1938. Of the total beer packaged, the proportion in cans has varied only from 13 percent in 1935, the year of its introduction, to 17 percent in 1937. Table 5 shows the percentage of all beer in packaged form and the percentage of packaged beer in cans.

TABLE 5.—*Percentage of Beer Packaged in Bottles and Cans, 1933–1938*

Year	Percentage of Beer Packaged	Beer in Cans as Percentage of Total Packaged Beer
1933	20%	(1)
1934	25	(1)
1935	30	13%
1936	30	15
1937	44	17
1938 (4 mos.)	45	13

Source: Based on data in *Metal Containers*, August, 1938, *Canco*, October, 1935, *Sales Management*, July 1, 1938, and *Steel*, January 6, 1936.
[1] Canned beer was not introduced until 1935.

[33] *Census of Manufacturers*, 1937, p. 2.

The percentage of beer put in cans or bottles depends upon several factors. First, there is the comparative cost of container and transportation for bottled and canned beer. Since the first cost of a beer can to the brewer is about the same as the cost of the better grade of bottle,[34] re-use of the bottle [35] makes it a cheaper packaging medium. On the other hand, transportation costs are higher for bottled than for canned beer. Thus, wide geographical distribution of a particular brand of beer involving considerable transportation costs, danger of bottle breakage and recovery difficulties in return of bottles for re-use tend to make cans less costly and more desirable than bottles. Consequently, in the export trade [36] and where the beer is shipped over long distances in the domestic market, the tin can has made large inroads in the bottled beer field.

Secondly, public taste, convenience and custom are important considerations in the use of the tin can. Tin cans save space, cool more quickly than bottles, and do not require a deposit or bookkeeping.[37] On the other hand, bottled beer was established before Prohibition, whereas canned beer was introduced in 1935. In restaurants, taverns, and hotels the public has become accustomed to bottled beer, and where the return of the empty bottle is not a problem, these intangible factors have a marked influence on the type of container which will be used. Since the introduction of tin beer cans, the can companies have advertised widely [38] the benefits of beer in cans, and public taste and custom have been partly altered in favor of cans.

The cost of tin plate in the tin beer can constitutes on the average less than 15 percent of the retail price of a can of beer.[39] Consequently a 10 percent reduction in the price of tin plate, if passed on entirely to the consumer, would reduce the price of a can of beer by only about fifteen hundredths of one cent. Since the cost of the tin plate is such a small part of the cost of a can of beer, and the use of cans for beer depends largely on geographical distribution and consumer acceptance, a change in the price of tin plate can have only a slight effect on the use of beer cans.

(2) *Lubricant Oil Cans.*—The lubricant oil industry is an important consumer of tin cans, using them as containers for its products in both domestic and export [40] markets. Several oil companies now market their lubricants exclusively in cans.[41]

The demand for tin cans as containers for motor oil depends, of course, on the demand for such oil. Lubricant oil consumption has shown an upward trend since 1921, which has been mainly due (1) to the increase in the number of cars, total motor vehicle registration having almost tripled from 1921 to 1937, and (2) to the 70 percent increase in the average mileage per car in this same period. The following table shows the increase in the lubricant oil consumption and motor vehicle registrations and the average mileage run during the period from 1921 to 1937:

TABLE 6.—*Lubricant Consumption, Motor Vehicle Registration, and Average Car Mileage, 1921–1937*

Year	Consumption of Motor Oil [1] (thousands of barrels)	Total Motor Vehicle Registration [2] (thousands of vehicles)	Mileage Run [3] (average per car)
1921	----------	10,463	6,080
1925	9,221	19,937	6,896
1929	11,526	26,501	8,752
1933	9,756	23,844	8,864
1937	12,653	29,705	[4] 10,304

Sources:
[1] *National Petroleum News*, January 11, 1939, p. 24.
[2] *Automobile Facts and Figures*, 1938, p. 16.
[3] G. Terborgh, *Passenger Automobiles Memorandum*, April 12, 1937, p. 2.
[4] 1936 figure used here.

[34] See Appendix, Tables 14 and 15.
[35] In 1937 only 17% of the beer sold as packaged beer was sold in cans, the balance of 83% being sold in bottles. Since, during such year, only 673 million beer bottles were produced as contrasted with 630 million beer cans, it would appear that each beer bottle was probably used on an average of five times (see Table 5 and Appendix, Table 15).
[36] According to one estimate, eighty percent of the packaged beer in the export trade is in cans. (*Steel*, January 3, 1938, p. 211.)
[37] International Tin Research and Development Council, Information Circular No. 1, *Canned Beer* (January, 1936).
[38] *Sales Management*, July 1, 1938.
[39] See Appendix, Tables 8 and 14.
[40] R. Skemp, *The Evolution of a Tin Can*, p. 16.
[41] International Tin Research and Development Council, *Tin Plate and Tin Cans in the United States*, Bulletin No. 4 (1936), p. 115.

This great increase in the consumption of lubricant oil has brought an increase in the use of oil cans.[42] As in the beer industry, the consumers in the past few years have learned the advantages of oil in sealed cans and have accordingly increased their consumption of oil in such containers.[43] Customers prefer such tin cans due to the assurance that the oil is free from contamination or substitution, and retailers favor canned oil because it is convenient and suitable for attractive displays and it permits greater diversification in grade of oil.[44] In part, however, the tendency to favor oil in cans is offset by declines in consumers' income, for a drop in income leads to the purchase of the cheaper grades of oil, which are sold in bulk.[45]

(3) *Paint and Varnish Cans.*—Consumption of general line cans by the paint and varnish industry has shown an upward trend subject, however, to wide fluctuations. Production of paints and varnishes rose steadily from 1919 to a peak in 1929, declined 45 percent to a low in 1932, and by 1935 recovered to 87 percent of the 1929 level.[46] The report of the National Resources Committee in *Patterns of Resource Use* found that the consumption of paints and varnishes was closely related to consumers' income.[47]

Since the cost of tin plate is only a fraction of the cost of the finished product in a tin container and since substitution of tin cans for other types of containers is a minor factor, tin plate prices are relatively unimportant in their effect on the consumption of paints and varnishes.

(4) *Other General Line Cans.*—Other industries which use general line containers also reflect this same general pattern of upward trend and dependence on consumers' income. Automobile polishes, waxes, and anti-freeze solutions sold in cans reflect the growth in the number and use of automobiles. The tobacco and chemical industries,[48] which use tin containers, both show a high degree of correlation with consumers' income.

The demand for general line cans necessarily follows closely the production of the products packed in the cans, which, in turn, is generally dependent primarily upon consumers' income. The cost of tin plate, which constitutes a small portion, usually less than 10 percent, of the retail price, is therefore only a minor influence in determining consumption of tin plate by these industries. Possibilities of substituting general line tin cans for other types of containers by a price reduction tend to be limited due to other factors such as fixity of public taste and difficulties of technical adaptation.

C. QUANTITY OF TIN PLATE PER CAN

The quantity of tin plate used in any specified tin can depends almost entirely on the product to be packed. The specifications for the composition of the tin plate, the manner of processing and the weight and amount of tin plate in the tin cans depend upon (1) variable corrosion, deformation and the other technical matters encountered in the packing of the different food stuffs and other materials and (2) needs of the canners, retailers, and consumers.[49] These technical factors control the quantity of tin plate used in a can designed for a particular use.

VI. Summary

The price of tin plate is of minor significance in determining its consumption. Since the demand for products packed in tin cans is generally not very elastic, and especially since the cost of tin plate is such a small proportion of the cost of the final product, a reduction in the price of tin plate would be ineffectual in increasing the consumption of steel. More fundamental forces such as consumers' income, public tastes, and technical considerations determine the demand for canned commodities and, hence, the consumption of tin plate by the canning industry.

[42] *Steel*, January 2, 1939, p. 149, and International Tin Research and Development Council, *op. cit.*, p. 115.

[43] *Sales Management*, July 1, 1938, p. 50.

[44] International Tin Research and Development Council, *op. cit.*, pp. 115–6.

[45] *Steel*, April 11, 1938, p. 23.

[46] National Resources Committee, *Patterns of Resource Use*, Preliminary Edition for Technical Criticism, March, 1939, p. 122. See also Appendix, Table 16.

[47] The amount of variation in the consumption of paints and varnishes explained by consumers' income is 95 percent. *Ibid.*

[48] The National Resources Committee found that tobbacco consumption was related to consumer income and a time trend and that the amount of variation explained was 96 percent; also that the consumption of chemicals was related to consumers' income and the Federal Reserve Board's index of industrial production, and that the amount of variation explained was 93 percent. Cf. National Resources Committee, *op. cit.*, pp. 104 and 121. Also see Appendix, Tables 17 and 18.

[49] International Tin Research and Development Council, *op. cit.*, especially pp. 67 and 88, and also the *Second General Report, 1937*, by the Council.

Appendix

Table 7.—*Production of Tin Cans and Utensils, 1937*

Type of Can	Number (millions of cans)	Value (millions of dollars)	Percent of Total Value
Packers Cans:			
Vent-hole top	1, 800. 1	$16. 1	4. 8%
Sanitary cans (including sweetened condensed milk cans)	9, 592. 2	168. 9	50. 4
General Line Cans:			
Miscellaneous cans and packages	[1] 4, 190. 1	130. 4	38. 9
Special general line cans:			
Beer cans	630. 9	14. 1	4. 2
Ice cream cans	1. 0	0. 5	0. 2
Dairy milk cans	1. 6	5. 0	1. 5
Total tin cans, utensils, etc	[1] 16, 215. 9	[2] 335. 0	100. 0

[1] The number of cans listed here is only the number reported whereas the value is for all cans, including 8 million dollars worth of cans for which numbers were not reported.
[2] Includes tin cans, utensils, etc., made as secondary products in other industries but does not include $18,537,673 of finished tinware, other than cans.

Sources: *Census of Manufactures*, 1937, "Tin Cans and Other Tinware."

Table 8

SECTION A—STEEL COSTS IN THE TIN CAN INDUSTRY, 1935

Value of Products of the Tin Can and Other Tinware Industry [1]	$287, 582, 216
Cost of Steel Materials Used in the Tin Can Industry [2]	170, 665, 145
Steel Costs as Proportion of Total Value of Products of the Tin Can Industry [3]	59. 3%

Sources: [1] *Census of Manufactures*, 1935, "Tin Cans and Other Tinware," p. 958. The coverage here is the same as for the steel materials and represents 98.4 percent of the aggregate value of products for the industry.
[2] See Section B below.
[3] Computed by dividing cost of steel materials by value of product.

SECTION B—STEEL MATERIALS CONSUMED BY THE TIN CAN INDUSTRY, 1935

Steel Product	Cost	Quantity Reported (net tons)[1]
Tin plate	$159, 938, 020	1, 404, 948
Terne plate	5, 911, 536	61, 193
Black plate	4, 815, 589	63, 745
All products	170, 665, 145	1, 529, 886

Source: *Census of Manufactures*, 1935, "Tin Cans and Other Tinware," p. 958.

[1] The reported tons cover 95 percent of the cost figures given, for in some cases only the value was reported.

Table 9.—*Tin plate and terne plate production, 1919–1937*

Year	Total Production of Tin Plate and Terne Plate (thousands of pounds)	Total Value of Tin Plate and Terne Plate (thousands of dollars)	Year	Total Production of Tin Plate and Terne Plate (thousands of pounds)	Total Value of Tin Plate and erne Plate (thousands of dollars)
1919	2, 539, 224	$175, 776	1929	4, 377, 488	209, 675
1921	1, 725, 781	96, 181	1931	3, 268, 025	140, 984
1923	3, 296, 551	162, 476	1933	3, 962, 956	148, 770
1925	3, 661, 837	188, 610	1935	4, 216, 002	192, 323
1927	3, 753, 474	190, 426	1937	6, 022, 908	278, 380

Source: *Census of Manufactures*, "Tin Plate and Terne Plate."

TABLE 10.—*Prices of tin plate and consumption of steel by the container industry, 1923–1938*

Year	Tin Plate Prices[1] (Dollars per base box)	Tin Plate Prices[1] Index (1929=100)	Consumption of Hot-Rolled Iron and Steel (thousands of gross tons)[2]	Year	Tin Plate Prices[1] (Dollars per base box)	Tin Plate Prices[1] Index (1929=100)	Consumption of Hot-Rolled Iron and Steel (thousands of gross tons)[2]
1923	$5, 42	101	1, 205	1931	4. 94	92	1, 415
1924	5. 50	103	1, 210	1932	4. 69	88	1, 037
1925	5. 50	103	1, 427	1933	4. 43	83	1, 759
1926	5. 50	103	1, 348	1934	5. 25	98	1, 557
1927	5. 48	102	1, 408	1935	5. 25	98	2, 039
1928	5. 25	98	1, 619	1936	5. 25	98	2, 455
1929	5. 35	100	1, 707	1937	[3] 5. 22	[3] 105	2, 784
1930	5. 19	97	1, 670	1938	[3] 5. 31	[3] 103	1, 908

Source:
[1] *Iron Age*, January 5, 1939, p. 198. These figures are average prices for the year at Pittsburgh.
[2] Computed by apportioning individual hot-rolled product totals on the basis of *Iron Age* distribution reports and by allocating jobber shipments to ultimate consumers. See M. W. Worthing. *The Distribution of Steel Products to Major Consuming Industries*, United States Steel Corporation, October 30, 1939.
[3] For a number of years prior to 1937, published prices were subject to a trade discount of 7½ percent. Since January 1, 1937, the published prices have been net. From January 1, 1938, to November 10, 1938, there was a refund of 25¢ per base box. A nominal list price comparable to those in the years preceding 1937, which takes these two factors into account, would have been $5.64 in 1937 and $5.51 in 1938. The index figures shown in the table for 1937 and 1938 are based upon these nominal list prices.
[4] Strip was included in container industry tonnage in 1938.

TABLE 11.—*Consumers' income, food production, and canned food consumption, 1919–1936*

Year	Consumers' Income (billions of 1936 dollars)[1]	Index of Food Production (1923–1925=100[2]	Consumption of Canned Foods: Amount (millions of pounds)[3]	Consumption of Canned Foods: Index (1923–1925=100)
1919	$46. 6	94	(4)	(4)
1920	47. 0	84	(4)	(4)
1921	42. 3	83	1891	59
1922	48. 8	94	2620	81
1923	54. 8	99	2890	90
1924	55. 4	103	2931	91
1925	57. 0	98	3847	119
1926	58. 3	97	3493	108
1927	58. 9	96	3590	111
1928	62. 2	98	3822	119
1929	65. 3	97	4096	127
1930	60. 4	93	4218	131
1931	54. 6	90	3404	106
1932	46. 7	87	3282	102
1933	48. 2	92	3568	111
1934	54. 0	99	3973	123
1935	56. 9	79	4753	148
1936	63. 9	90	(4)	(4)

Sources:
[1] National Resources Committee, *Patterns of Resource Use*, March, 1939, p. 92.
[2] Federal Reserve Board, Division of Research and Statistics, June, 1937.
[3] National Resources Committee. *Patterns of Resource Use.* March. 1939. p. 103.
[4] Data not given.

TABLE 12.—*Food Packs and Tin Plate Price, 1920–1938*

Year	Food Packs[1] (thousands of cases)			Price of Tin Plate[2] (dollars per base box)
	#3 Tomatoes	#2 Corn	#2 Peas	
1920	11,368	15,040	12,317	$7.53
1921	4,017	8,843	8,207	5.90
1922	11,538	11,419	13,042	4.73
1923	14,672	14,106	13,948	5.42
1924	12,519	12,131	19,315	5.50
1925	19,770	24,320	17,816	5.50
1926	9,455	19,069	17,709	5.50
1927	13,137	10,347	12,936	5.48
1928	8,539	14,497	17,943	5.25
1929	14,145	17,487	18,530	5.35
1930	16,998	15,692	22,035	5.19
1931	9,573	19,415	13,286	4.94
1932	16,028	9,358	10,367	4.69
1933	11,986	10,193	12,893	4.43
1934	22,376	11,268	15,742	5.25
1935	26,985	21,471	24,699	5.25
1936	24,209	14,621	16,553	5.25
1937	26,076	23,541	23,467	[3] 5.22
1938	22,960	20,470	25,459	[3] 5.31

[1] Data on packs from *The Canning Trade, Almanac of the Canning Industry*, 1939, p. 208.
[2] *Iron Age*, January 5, 1939, p. 200. These figures are averages for the year and represent tin plate prices at Pittsburgh.
[3] A list price comparable to those in the years preceding 1937 would have been $5.64 in 1937 and $5.51 in 1938. See note 3 to Table 10.

TABLE 13.—*Prices of Tin Plate and Average Retail Prices of Canned Foods in 51 Cities Combined, 1923–1938*

Year	Canned Foods[1] (cents per can)					Tin Plate[2] (dollars per base box)
	Salmon Red (16 oz. can)	Peas (No. 2 can)	Corn (No. 2 can)	Tomatoes (No. 2 can)	Milk Evaporated (14½ oz. can)	
1923	30.1¢	17.3¢	15.4¢	12.5¢	10.9¢	$5.42
1924	30.1	17.9	16.0	12.8	10.2	5.50
1925	32.2	17.9	17.6	13.2	10.2	5.50
1926	36.6	17.1	16.3	11.8	10.3	5.50
1927	32.7	16.5	15.7	11.9	10.3	5.48
1928	33.7	16.6	15.9	11.7	10.0	5.25
1929	31.1	16.5	15.8	12.8	9.8	5.35
1930	32.1	16.0	15.3	12.1	9.1	5.19
1931	32.2	14.0	13.3	10.1	8.2	4.94
1932	24.3	12.7	10.6	9.3	6.8	4.69
1933	19.3	12.8	10.1	9.1	6.5	4.43
1934	21.1	16.6	11.5	10.5	6.7	5.25
1935	22.1	17.1	12.5	10.1	7.0	5.25
1936	25.3	16.1	12.0	9.4	7.6	5.25
1937	25.6	16.2	12.9	9.3	7.6	[3] 5.22
1938	25.7	15.1	11.6	8.8	7.1	[3] 5.31

Sources:
[1] *Retail Prices of Food*, 1923–36, United States Dept. of Labor, Bureau of Labor Statistics, pp. 80–90. Also *Retail Prices*, Jan., 1938, p. 12, and Jan. 1939, pp. 12, 13.
[2] Tin plate prices are average prices for the year at Pittsburgh. Cf. *Iron Age*, January 5, 1939, p. 200.
[3] A list price comparable to those in the years preceding 1937 would have been $5.64 in 1937 and $5.51 in 1938. See note 3 to Table 10.

TABLE 14.—*Cost of Containers and Retail Price of Beer, New York City*

Type of Container	Cost of Container (cents per can)[1]	Retail Price of Beer (cents per can)	
		Locally produced	Produced elsewhere
Cans	2.136¢	10.0¢	10.0 to 12.5¢
Bottles	[2] 2.100	[3] 8.33	[3] 12.5

Source: Information supplied by trade, October, 1939.

[1] Prices quoted in quantities of 1,000 units.
[2] Represents better class of bottles, re-used a number of times. For a cheaper grade of re-used bottles the price quoted was $19.90 per 1000 and for "one-trip" bottles it was $17.55 per 1000. Compare average value of can and bottle in Table 15.
[3] Prices quoted for case of 24 cans or bottles. Bottle deposits excluded.

TABLE 15.—*Beer Bottles and Beer Cans, 1937*

	Number Produced	Value of Product	Average Value per Container
Beer bottles	673,053,408	$13,382,049	1.99¢
Beer cans	630,896,567	14,108,829	2.24¢

Source: *Census of Manufactures*, 1937, "Glass" and "Tin Cans and Other Tinware".

TABLE 16.—*Production of Paints and Varnishes, and Consumers' Income, 1919–1935*

Year	Index of Varnish and Paint Production (1929=100)	Consumers' Income (billions of 1936 dollars)	Year	Index of Varnish and Paint Production (1929=100)	Consumers' Income (billions of 1936 dollars)
1919	49.9	46.6	1928	96.2	62.2
1920	54.6	47.0	1929	100.0	65.3
1921	44.6	42.3	1930	81.6	60.4
1922	59.3	48.8	1931	70.6	54.6
1923	67.5	54.8	1932	55.6	46.7
1924	71.0	55.4	1933	60.4	48.2
1925	78.7	57.0	1934	70.7	54.0
1926	79.6	58.3	1935	86.6	56.9
1927	87.6	58.9			

Source: National Resources Committee, *Patterns of Resource Use*, Preliminary Edition for Technical Criticism, 1939, p. 122.

TABLE 17.—*Tobacco Consumption and Consumers' Income, 1919–1936*

Year	Tobacco Consumption (1923–1925=100)	Consumers' Income (billions of 1936 dollars)	Year	Tobacco Consumption (1923–1925=100)	Consumers' Income (billions of 1936 dollars)
1919	82	$46.6	1928	124	62.2
1920	87	47.0	1929	134	65.3
1921	85	42.3	1930	131	60.4
1922	89	48.8	1931	123	54.6
1923	96	54.8	1932	111	46.7
1924	99	55.4	1933	116	48.2
1925	105	57.0	1934	128	54.0
1926	112	58.3	1935	135	56.9
1927	118	58.9	1936	151	63.9

Source: National Resources Committee *Patterns of Resource Use*, Preliminary Edition for Technical Criticism, 1938, p. 104.

TABLE 18.—*Consumption of Chemicals, Industrial Production, and Consumers' Income, 1923–1935*

Year	Consumption of Chemicals (1929=100) [1]	Average Industrial Production and Consumers' Income (1923–5 =100) [2]	Consumers' Income (billions of 1936 dollars)	Year	Consumption of Chemicals (1929=100) [1]	Average Industrial Production and Consumers' Income (1923–5 =100) [2]	Consumers' Income (billions of 1936 dollars)
1923	64.1	100	54.8	1930	89.7	102	60.4
1924	58.1	97	55.4	1931	78.2	90	54.6
1925	66.6	103	57.0	1932	61.3	74	46.7
1926	76.4	106	58.3	1933	77.8	81	48.2
1927	75.2	106	58.9	1934	87.5	88	54.0
1928	92.2	112	62.2	1935	90.7	96	56.9
1929	100.0	118	65.3				

Sources: National Resources Committee, *Patterns of Resource Use*, Preliminary Edition for Technical Criticism, 1939, p. 121.

[1] The production series given in summary was adjusted for imports and exports as given in the *Statistical Abstract of the United States.*

[2] Consmer income is reduced to a 1923–25 base; this is combined with the Federal Reserve Board index of industrial production, each series being weighted equally.

EXHIBIT NO. 1416

AN ANALYSIS OF STEEL PRICES, VOLUME AND COSTS—CONTROLLING LIMITATIONS ON PRICE REDUCTIONS

This analysis was prepared by the United States Steel Corporation in connection with its studies in preparation for the hearings on the steel industry before the Temporary National Economic Committee. The work was under the supervision of Theodore O. Yntema, Professor of Statistics, University of Chicago.

OCTOBER 30, 1939.

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I. PURPOSE OF THE STUDY

The success of mass production methods in American industrial practice has given much emphasis to the importance of volume in reducing costs. Failure to appreciate, in the case of the steel industry, the limitations of the extent to which increased volume means reduced costs per unit of product has frequently been made the basis of the charge that steel prices are higher than they should be and that the absence of price competition, rather than the limitation imposed by costs, is the reason why steel prices are not lower than they are. It is further said that if steel prices were lowered in times of recession more steel would be sold and payrolls and employment would be better maintained. The fact of the matter is that steel prices are not high. In recent years they have barely covered costs. This is evidenced by the fact that in the last ten years, 1929 to 1938, the United States Steel Corporation realized a return of only 1.91% on the combined investment of the bondholders and stockholders. From 1930 to 1938 the rate of return averaged less than 1% per year.

However, the contention that steel prices are too high is not made in ignorance of the small margin of profit currently being realized on sales. The theory of

those who would lower steel prices is that such reductions greatly stimulate sales and that volume and costs are so inter-related in the production of steel that, on the mass production principle, the cost per ton would be drastically reduced if volume were increased. Hence, it is argued that if prices were reduced, volume would be stimulated to a point where costs would drop sufficiently to make steel production profitable at the reduced prices. It has been the purpose of this study to ascertain the increases in volume that would have to take place to offset various decreases in steel prices by the United States Steel Corporation subsidiaries, taking into consideration the effect of increased volume on costs, and to estimate the financial gain or loss which would result from price reductions.

II. Summary of Findings

1. The total annual costs of the United States Steel Corporation and its subsidiaries may be divided into (1) those which must be met regardless of the tonnage of steel produced and (2) the additional costs of producing each additional ton of product. Taking the costs shown by the profit and loss statements of the Corporation from 1927 to 1938 and adjusting to 1938 wage, interest, and tax rates, and to 1938 prices and other operating conditions, this study shows that under 1938 conditions the costs of the first or fixed type amount to $182,100,000 per year while those of the second type, the additional costs, are approximately $55.73 per weighted ton of product shipped.[1] Thus the total costs for any volume of business at 1938 wage, interest, and tax rates, and 1938 material prices, may be estimated by multiplying the weighted tons shipped by $55.73 and adding $182,100,000 to the result. It should be noted, however, that while these costs are exclusive of all non-operating income and expense, they cover all operations of the Corporation's subsidiaries and hence do not represent merely the cost of producing steel. Furthermore, even weighted tonnages shipped do not reflect the full volume of business, since some goods and services are sold by the Corporation's subsidiaries which are not measured in tons. Nevertheless, the other operations rise and fall with increases and decreases in shipments of products to a sufficient extent that the total costs maintain approximately the relationship to shipments just described.

2. Within the range of actual experience the additional costs, at 1938 wage and tax rates and 1938 material prices, arising with the shipment of each additional ton remain constant at $55.73. This is true when production averages as high as 90.4% and as low as 17.7% of ingot capacity for the entire year. While the additional costs per ton tend to remain constant, the average costs per ton decrease as the volume of shipments rises since the fixed costs of $182,100,000 are spread over a greater number of tons.

3. An approximation of the elements composing the total costs of the United States Steel Corporation and its subsidiaries is shown below:

Table 1.—*Elements of Total Costs 1938 Conditions—United States Steel Corporation and Subsidiaries*

Item	Costs that must be met regardless of operating rate	Additional cost for each additional ton [1] of product shipped
Interest	$8, 300, 000	$0. 00
Pensions	7, 700, 000	0. 00
Taxes other than Social Security and Federal Income	24, 200, 000	1. 43
Payroll	62, 100, 000	29. 10
Social Security Taxes	2, 500, 000	1. 16
Other Cash Expenses	47, 800, 000	21. 67
Total Cash Costs	152, 600, 000	53. 36
Depreciation and Depletion	29, 500, 000	2. 37
Total costs	$182, 100, 000	$55. 73

[1] Tonnage weighted to adjust for variation from normal proprotions of high and low cost products and for shipments of products other than steel.

[1] By weighted tons are meant tonnages of each type of product shipped (except cement and certain liquid and gaseous coke-oven-by-products), converted, on an average mill cost basis, to equivalent tons of average cost rolled and finished steel products. In this way adjustment is made for (1) variations in the types of steel products constituting the total shipments and (2) shipments of products other than steel.

4. The elasticity of demand for a product is measured by the ratio of the relative resulting increase in volume to the relative decrease in price. Assuming that, as all analyses indicate, steel has an elasticity of demand no greater than 1, and that competitive meeting of prices would prevent increased participation in the going volume of business, the relative increase in shipments attributable to a price reduction by the Corporation would not be greater than the relative decrease in prices, and the total sales in dollars would not be increased. Under these circumstances, the smallest general drop in steel prices that could possibly have raised the 1938 volume of steel sold to 1937 levels would have been 40.9%. A price reduction of this proportion, even if successful in restoring 1937 volume, would have resulted in a cash loss for the year of $219,920,000 and a total loss to the Corporation, including depreciation and depletion, of $280,704,000. Such a cash loss, if continued, would have exhausted the average 1938 working capital in less than two years and annual total losses on this scale would wipe out the entire equity of preferred and common stockholders existing on December 31, 1938 in about four and a half years.

5. Any reduction in steel prices below the average prices prevailing in 1938 would have served only to increase the 1938 deficit of the Corporation which amounted to $8,758,572, exclusive of non-operating income and expense. Even if the elasticity of demand for steel is assumed to be as high as 1, the estimated additions to the 1938 deficit which would have resulted from various price reductions would have been as follows:

Table 2.—*Estimated Additions to 1938 Deficit—How Deficit Would Have Increased if Prices Had Been Reduced and Volume Had Increased to Same Relative Extent—United States Steel Corporation and Subsidiaries*

Reduction in average price	Estimated addition to deficit	Reduction in average price	Estimated addition to deficit
1%	$3,900,000	15%	$68,700,000
5%	20,500,000	20%	97,400,000
10%	43,300,000		

6. Because of the low elasticity of demand for steel, the increase in volume resulting from a reduction in price is certain to be less than the increase needed to offset the adverse effects of the lower price on profits. Regardless of the volume of operations taken as a starting point, the percentage increases in volume necessary to compensate for various percentage reductions in the average 1938 prices, so that profits or losses would neither be increased or decreased by the price reduction, are as shown below. Also shown are the percentage increases in volume which would result if the elasticity of demand for steel were as high as 1.

Table 3.—*Increases in Volume Needed to Compenstate for Decreases in Average 1938 Prices, Compared to Maximum Probable Resulting Increases in Volume—United States Steel Corporation and Subsidiaries*

Reduction in price	Increase in volume required to offset price decrease	Greatest probable resulting increase in volume	Reduction in price	Increase in volume required to offset price decrease	Greatest probable resulting increase in volume
1%	3.4%	1.0%	15%	96.7%	17.7%
5%	19.6%	5.3%	20%	190.3%	25.0%
10%	48.8%	11.1%			

7. At average prices prevailing in the second half of 1938, subsequent to the June 24, 1938 price reduction, the percentage increases in volume required to offset further price reductions would be even higher.

TABLE 4.—*Increases in Volume Needed to Compensate for Decreases in 2nd Half 1938 Prices, Compared to Maximum Probable Resulting Increases in Volume—United States Steel Corporation and Subsidiaries*

Reduction in price	Increase in volume required to offset price decrease	Greatest probable resulting increase in volume	Reduction in price	Increase in volume required to offset price decrease	Greatest probable resulting increase in volume
1%	4.0%	1.0%	15%	138.4%	17.7%
5%	24.0%	5.3%	20%	342.6%	25.0%
10%	63.1%	11.1%			

8. No percentage of capacity as ordinarily computed can be named as the break-even point for any given level of steel prices, since the exact percentage at which the Corporation would break even will also depend upon the type of products composing the total tonnage sold and these vary considerably from month to month and from year to year, even when total shipments are approximately the same. On a weighted tonnage basis, the break-even point for the Corporation at prices prevailing in the second half of 1938 would be at about ten and a half million weighted tons. Depending on the type of products sold, this weighted tonnage would be equivalent to from 50% to 55% of capacity.

9. If prices were reduced to the point where the Corporation would break even only if operations averaged around 90% of capacity, which some critics have suggested as the proper break-even point, the Corporation would have to operate at the impossible annual rate of 130% of capacity to make a 5% return on its investment in tangible assets.

III. Costs of United States Steel Corporation in Relation to Volume

Costs must of necessity fall into one of two categories. Some items of cost are the same regardless of the amount of steel and other products produced providing there is not a complete shutdown. These costs are known as "fixed costs" or "overhead costs". There are other items of cost termed "variable costs" or "incremental costs" or "additional costs" which are not the same regardless of volume but increase with increases in the volume of steel produced and sold. These costs can be diminished by cutting down the production of steel. The fixed costs, on the other hand, cannot be diminished except by complete shutdown, but they can be spread over a greater number of units of products by increasing production. Both the variable and the fixed costs are composed both of costs which embrace current cash outlays, and of depreciation and depletion, which do not.

The cost pattern of the United States Steel Corporation and its subsidiaries, set forth in the summary of findings in Section II above, has been derived from the profit and loss statements of the Corporation as set forth in a financial report covering the years 1917 to 1937, submitted to the Federal Trade Commission on February 17, 1939, in connection with the Commission's studies relative to the Temporary National Economic Committee. A profit and loss statement for 1938 on a comparable basis was prepared by the Comptroller's Department of the Corporation. These profit and loss statements are basically the same as those contained in the annual reports of the Corporation, except that some of the items have been reclassified in order to render all of the yearly statements comparable and to comply with certain requests of the Federal Trade Commission. Only the figures from 1927 onward were used in this study because the data for making the necessary adjustments were not available for prior years.

The total operating costs as shown on the profit and loss statements referred to consist of the cost of goods sold and operating expenses of transportation and other incidental operations, plus the selling, general and administrative expenses, and taxes other than Federal income and profits, plus provisions for depreciation and depletion. To the total of these operating costs was added the amount of the idle plant expenses, and from that total was subtracted the amount of the discounts from purchases. These last two items were classified in the report under "Other Income Deductions" and "Other Income," respectively, but it was felt that they were sufficiently connected with operations to be included in the operating costs for the purpose of this study. Also added in was the amount of the interest on bonds, mortgages and other long-term debt. Items classified under

"Other Income" and "Other Income Deductions," with the exception of the idle plant expenses and purchase discounts, were considered to be extraneous non-operating income and expense and were not included in the computation. Federal income and profits taxes were excluded for a different reason. These taxes are dependent on profits, not on costs or volume of business, and hence will differ with different prices that may prevail. Since the purpose of this study was to chart a cost curve which could be related to estimated sales and revenues at various price levels, these profits taxes have been omitted from the costs and any profits or losses shown in this study are before provision for Federal income and profits taxes. The various components of total costs, as extracted from the above mentioned report, are shown in columns 2, 3, 4 and 5 of Table 5.

TABLE 5.—*Compilation of Total Costs Exclusive of Inter-Company Items and Costs Connected with Extraneous Transactions*[1]*—United States Steel Corporation and Subsidiaries*

(1) Year	(2) Operating Costs[2]	(3) Add: Idle Plant Expenses	(4) Less: Purchase Discounts	(5) Add: Bond Interest	(6) Less: Estimated Inter-Company Transactions (Table 6)	(7) Total Costs After Elimination of Inter-Company Items[3]
1927	1, 211, 837, 563	1, 822, 861	1, 000, 490	26, 063, 504	371, 721, 399	867, 002, 039
1928	1, 246, 408, 662	2, 550, 146	909, 916	25, 746, 009	389, 268, 104	884, 526, 797
1929	1, 298, 859, 622	1, 679, 794	983, 886	14, 944, 870	434, 445, 063	880, 055, 337
1930	1, 078, 516, 167	2, 516, 129	1, 153, 639	5, 640, 096	360, 637, 726	724, 881, 027
1931	733, 392, 971	2, 904, 457	831, 634	5, 469, 624	201, 536, 082	539, 399, 336
1932	424, 275, 927	3, 084, 823	275, 219	5, 313, 461	71, 173, 131	361, 225, 861
1933	557, 631, 125	3, 160, 905	525, 447	5, 164, 453	150, 992, 224	414, 438, 812
1934	606, 196, 210	2, 694, 390	716, 245	5, 051, 052	170, 362, 492	442, 862, 915
1935	769, 564, 100	2, 089, 259	939, 641	4, 959, 780	236, 439, 013	539, 234, 485
1936	1, 035, 128, 989	1, 396, 989	1, 455, 169	4, 918, 431	308, 210, 336	731, 778, 904
1937	1, 269, 970, 378	1, 136, 149	1, 815, 869	5, 141, 088	373, 947, 630	900, 484, 116
1938	765, 723, 200	2, 440, 185	993, 387	8, 262, 327	160, 898, 753	614, 533, 572
Total	10, 997, 504, 914	27, 476, 087	11, 600, 542	116, 674, 695	3, 229, 631, 953	7, 900, 423, 201

[1] The figures herein contained, except the estimated inter-company items, have been taken from the consolidated profit and loss statemeuts submitted to the Federal Trade Commission on 2/17/39. The figures are reconcilable with those appearing in the Annual Reports, but are not exactly the same, as some reclassification was necessary in order to comply with the Commission's request and also to put the statements for all years on a comparable basis.

[2] As per statement to Federal Trade Commission consists of (1) cost of goods sold and operating expenses of transportation and other incidental operations; (2) selling, general administrative expenses, and taxes other than Federal income and profits taxes; (3) provisions for depreciation and depletion. Additions to bond sinking fund reserve are included in depreciation in 1927 and 1928.

[3] Excluding income and expense connected with non-operating transactions.

The costs that would be obtained by adding together these components, however, would involve a certain amount of duplication, for on the profit and loss statements both the sales and revenues and the cost of goods sold and operating expenses of transportation and miscellaneous operations include transactions between the subsidiary companies of the United States Steel Corporation. Since the inter-company sales of any one company constitute the costs of the other, and since inter-company profits are eliminated from inventory valuations in making inventory adjustments, both costs and sales and revenues are inflated, from a consolidated viewpoint, by the amount of the inter-company items, but the profit shown is unaffected by this method of handling.[2] These inter-company transactions are segregated in the accounts of the Corporation and its subsidiaries and in the annual reports so far as the sales of products and some of the miscellaneous operations are concerned, but the accounting systems of the common carrier transportation companies make no provision for this segregation. Consequently, the inter-company business done by the common carrier transportation companies must be estimated. Estimates of the net sales and operating revenues with all of the inter-company items eliminated had already been prepared by the Comptroller's Department of the Corporation. By subtracting these net sales and operating revenues derived from outside sources from the total of net sales and operating revenues shown in the profit and loss statements submitted to the Federal Trade Commission, the estimated amount of all inter-company items was

[2] See Appendix VII for illustration and more complete discussion.

ascertained. This computation is shown in Table 6. Since the relationship between the physical volume of outside business and the cost of doing all outside business was what was desired, the inter-company items had to be deducted from the costs which were taken from the report ot the Federal Trade Commission. The deduction of the inter-company items estimated in Table 6 is made in column 6 of Table 5. Column 7 of Table 5 shows the total operating costs on an integrated basis for each of the years 1927 to 1938.

TABLE 6.—*Estimate of Inter-Company Transactions—United States Steel Corporation and Subsidiaries*

Year	Net Sales and Operating Revenues [1]	Net Sales and Operating Revenues less Inter-Company Items [2]	Estimated Inter-Company Items
1927	1,318,334,399	946,613,000	371,721,399
1928	1,381,843,104	992,575,000	389,268,104
1929	1,502,211,063	1,067,766,000	434,445,063
1930	1,175,046,726	814,409,000	360,637,726
1931	725,248,082	523,712,000	201,536,082
1932	354,693,131	283,520,000	71,173,131
1933	521,943,224	370,951,000	150,992,224
1934	588,835,492	418,473,000	170,362,492
1935	776,348,013	539,909,000	236,439,013
1936	1,099,931,336	791,721,000	308,210,336
1937	1,395,549,630	1,021,602,000	373,947,630
1938	766,673,753	605,775,000	160,898,753
Totals	11,606,657,953	8,377,026,000	3,229,631,953

[1] As per Statement to Federal Trade Commission, 2/17/39.
[2] As per data prepared by Comptroller's Department of U. S. Steel Corporation—Does not include Miscellaneous Non-Operating Income.

To ascertain the relationship between costs and volume, it was necessary to compare the above costs with the related volume figures. Since the cost figures were obtained from the profit and loss statements, they represent the cost of goods sold rather than the cost of goods manufactured and hence are comparable with the number of tons shipped each year rather than with the number of tons produced. In relating costs to shipments, however, it is necessary to make some adjustment for changes in the proportions of high and low cost products constituting the total. For instance, if the shipment figures showed that in each of two years 10,000,000 tons had been shipped, the total costs would be greater in the year in which costly products, such as sheets and tin plate, constituted most of the tonnage than in the year when lower cost products, such as rails and heavy plates, predominated. Adjustment for such a condition has been made by letting each ton of rolled and finished steel product which is of a type whose 1933–1937 average mill cost was less than the average cost of all rolled and finished steel products, count proportionately less than a full ton, while tons of products of a class which is on the average more costly than the average cost of rolled and finished steel products, have been made to count proportionately more than a full ton. By weighting in this way the number of tons of all tonnage products shipped each year has been converted into equivalent tons of average cost rolled and finished steel products.[3] Thus in any years in which the 1933–1937 average proportions of high and low cost products were sold the actual tonnage is the same as the weighted tonnage, while the total tonnage for years having an abnormal proportion of high or low cost products has been converted to a tonnage figure that is comparable to the normal years from a cost standpoint. By a similar weighting process, the total tonnage of rolled and finished products shipped has been further adjusted to include the equivalent tons of steel represented by the products other than steel which are sold on a tonnage basis by the Corporation's subsidiaries.

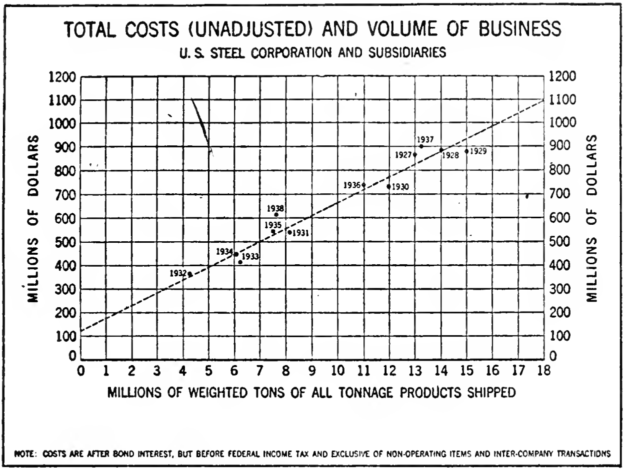
[3] The total tons shipped are gross tons except with respect to a few products included on a net tonnage basis, and the average cost per ton is the average for this mixed tonnage.

TABLE 7.—*Total Costs (Unadjusted) and Volume of Business—United States Steel Corporation and Subsidiaries*

Year	Total Costs (Table 5)	Millions of Weighted Tons of Products Shipped	Year	Total Costs (Table 5)	Millions of Weighted Tons of Products Shipped
1927	$867,002,039	13.0	1933	$414,438,812	6.2
1928	884,526,797	14.0	1934	442,862,915	6.1
1929	880,055,337	15.1	1935	539,234,485	7.6
1930	724,881,027	11.9	1936	731,778,904	11.0
1931	539,399,336	8.1	1937	900,484,116	13.2
1932	361,225,861	4.4	1938	614,533,572	7.8

In Table 7 the total costs as shown in Table 5 are compared with the weighted tons of all products shipped. In Chart 1 these costs are plotted in relation to the weighted tons shipped. It is apparent from this chart that there is a close relationship between total costs and tonnages shipped and that this relationship is of such a nature that it appears as a straight line in the graph.

CHART 1



Fitting a straight line in such a way that the sum of the squares of the vertical deviations of each of the points from the line is at a minimum, it appears that the average relationship between costs and volume for the period 1927 to 1938 was such that the total costs consisted of $54.51 per ton sold, plus fixed costs of $120,530,000. However, this relationship represents the relation prevailing on the average under all the changing conditions that took place between 1927 and 1938. An inspection of the chart reveals clearly that the costs in the earlier years were generally lower than average, while in the later years they have been above this average. This shows that the present-day costs of producing steel are higher than they formerly were. To ascertain what the relationship between cost and volume would be under 1938 conditions it was necessary to adjust the cost figures for each of the prior years for changes in interest, tax and wage rates, material prices, and other conditions that have since taken place.

Since different changes have taken place in the various types of expenses, the first step in attempting an adjustment of the data to 1938 conditions was to break down the total costs into their principal components. Table 8 gives this breakdown. The components shown are (1) taxes other than Federal income and profits

taxes and social security taxes, (2) interest, (3) depreciation and depletion, (4) payroll, (5) pensions, (6) social security taxes, and (7) other expenses. Payroll figures do not exactly reflect the salary and wage cost in the goods sold because some payroll goes into inventory and some of the goods sold are taken from the previous year's inventory. To the extent that payroll is more or less than the wage and salary cost in goods sold in any particular year because of production exceeding or being less than shipments, the "other expense" component is understated or overstated. The amount of inventory fluctuation is relatively small, however, and the effect on the ultimate cost computation is negligible. With the breakdown of costs computed, the adjustments applied to each component must be considered.

Two of the components, interest and pensions, are in no way dependent upon the volume of business performed. These items are completely fixed. Hence, to convert to 1938 conditions, all that had to be done was to substitute in each year the 1938 amount of interest and pensions paid.

TABLE 8.—*Analysis of Operating Costs Into Components—United States Steel Corporation and Subsidiaries*

Year	Total Costs Before Income Taxes as per Table 5	Taxes Other than Federal Income and Profits Taxes and Social Security [1]	Interest	Depreciation and Depletion [2]	Payroll [3]	Pensions [6]	Social Security Taxes	Other Expenses
1927	867, 002, 039	34, 817, 116	26, 063, 504	58, 906, 007	410, 289, 135	2, 414, 226	----------	334, 512, 051
1928	884, 526, [illegible]97	36, 015, 942	25, 746, 009	67, 237, 303	400, 000, 492	2, 924, 879	----------	352, 602, 172
1929	880, 055, [illegible]37	37, 739, 322	14, 944, 870	63, 274, 163	406, 886, 492	3, 354, 504	----------	353, 855, 986
1930	724, 881, 027	[4] 36, 047, 026	5, 640, 096	58, 550, 120	367, 945, 736	3, 772, 053	----------	252, 925, 996
1931	539, 399, 336	33, 162, 707	5, 469, 624	47, 317, 895	253, 178, 649	5, 241, 466	----------	195, 028, 995
1932	361, 225, 861	31, 943, 315	5, 313, 461	40, 319, 794	131, 602, 678	6, 904, 978	----------	145, 141, 635
1933	414, 438, 812	33, 288, 485	5, 164, 453	43, 584, 499	160, 746, 223	7, 163, 032	----------	164, 492, 120
1934	442, 862, 915	32, 615, 831	5, 051, 052	44, 579, 309	207, 564, 103	7, 223, 546	----------	145, 829, 074
1935	539, 234, 485	[5] 34, 691, 330	4, 959, 780	47, 801, 389	246, 508, 043	7, 362, 723	----------	197, 911, 220
1936	731, 778, 904	37, 999, 606	4, 918, 431	55, 466, 762	328, 070, 724	7, 642, 026	4, 081, 587	293, 599, 768
1937	900, 484, 116	45, 132, 333	5, 141, 088	59, 589, 159	426, 330, 944	7, 380, 254	13, 415, 904	343, 494, 434
1938	614, 533, 572	34, 602, 915	8, 262, 327	48, 532, 841	275, 364, 898	7, 743, 046	11, 309, 216	228, 718, 329
	7, 900, 423, 201	428, 055, 928	116, 674, 695	635, 159, 241	3, 614, 488, 117	69, 126, 733	28, 806, 707	3, 008, 111, 780

[1] Total taxes as per profit and loss statements in annual reports, less reserves for Federal income and profits taxes as per report to Federal Trade Commission and social security taxes as per profit and loss statements in annual reports.

[2] Does not include cost of dismantling, moving and rearranging facilities, which is included in depreciation and depletion in the profit and loss statement in the annual reports from 1936 on.

[3] Excluding construction payroll.

[4] Excluding certain taxes charged against special income.

[5] As per 1936 annual report—iron ore taxes not segregated from other overhead in 1935 annual report profit and loss statements.

[6] Figures for 1928 to 1938 as per annual reports and the S. E. C. registration statement, Form A-2; figure for 1927 supplied by Comptroller's Department of the Corporation.

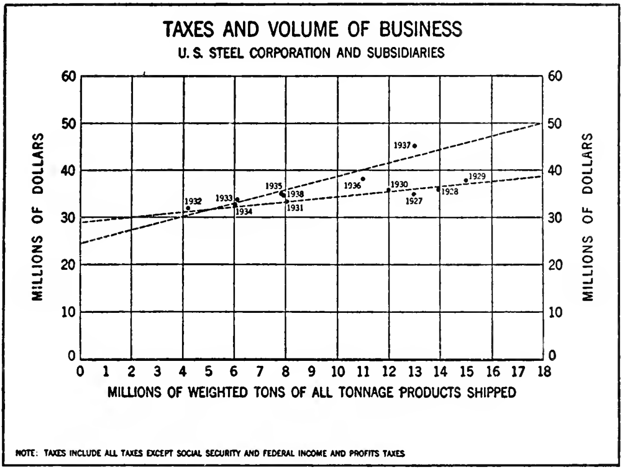
Since tax rates have changed considerably over the period under consideration, it is clear that some adjustment in the tax figures was necessary. In Table 9 the taxes, other than social security and Federal income and profits taxes, are

TABLE 9.—*Taxes and Volume of Business—United States Steel Corporation and Subsidiaries*

Year	Taxes Other than Social Security and Federal Income and Profits Taxes	Millions of Weighted Tons of Products Shipped	Year	Taxes Other than Social Security and Federal Income and Profits Taxes	Millions of Weighted Tons of Products Shipped
1927	34, 817, 116	13. 0	1933	33, 288, 485	6. 2
1928	36, 015, 942	14. 0	1934	32, 615, 831	6. 1
1929	37, 739, 322	15. 1	1935	34, 691, 330	7. 6
1930	36, 047, 026	11. 9	1936	37, 999, 606	11. 0
1931	33, 162, 707	8. 1	1937	45, 132, 333	13. 2
1932	31, 943, 315	4. 4	1938	34, 602, 915	7. 8

compared with the weighted tons of products shipped. The relationship between taxes and volume was then ascertained by plotting taxes against shipments as shown on Chart 2. An inspection of the chart shows that the points for 1927 to 1931 fall approximately along one line, while the points for 1932 to 1938 fall along another. The simplest estimate of what the taxes would be at various rates of operation under 1938 conditions was to compute the average relationship, by the least squares method referred to above, for the period 1932 to 1938. It will be noted that the 1938 taxes fall very close to the line and very close to the points for other years when volume was about the same. Hence it is evident that the tax rates which affect the Corporation with regard to taxes other than Federal income and social security taxes, have not been materially

CHART 2



altered throughout the 1932-1938 period. The taxes paid from 1927 to 1931, however, are clearly much below what would be paid today at the same operating rates. For this reason in this study the actual taxes paid for each of the years 1932 to 1938 have been used in computing the estimated total costs under 1938 conditions, but the taxes for the years prior to 1932 have been estimated on the basis of the average 1932 to 1938 tax-volume relationship. This relationship indicates that total taxes, other than Federal income and social security, amount to $24,217,000, plus $1.43 for each weighted ton of product sold. The calculation of the estimated taxes for the years 1927 to 1931 is shown in Table 10. The final estimate of the taxes, other than social security and Federal income taxes, that would be paid under present tax laws at various volumes of production is shown in Table 11.

TABLE 10.—*Estimated Taxes (Other Than Social Security and Federal Income) in Prior Years if 1932–1938 Rates Had Prevailed—United States Steel Corporation and Subsidiaries*

[Taxes=$24,217,000+$1.433 per weighted ton shipped [1]]

Year	Millions of Weighted Tons Shipped	Fixed (Millions of Dollars)	Variable (Millions of Dollars)	Total Taxes (Millions of Dollars)
1927	13.009	24.217	18.642	42.859
1928	13.994	24.217	20.053	44.270
1929	15.089	24.217	21.623	45.840
1930	11.935	24.217	17.103	41.320
1931	8.131	24.217	11.652	35.869

[1] 1932–1938 average relationship of taxes in relation to volume.

TABLE 11.—*Taxes and Volume of Business, Under Present Tax Laws—United States Steel Corporation and Subsidiaries*

Year	Taxes Other than Social Security and Federal Income	Millions of Weighted Tons of Products Shipped	Year	Taxes Other than Social Security and Federal Income	Millions of Weighted Tons of Products Shipped
1927	[1] $42,859,000	13.0	1933	33,288,485	6.2
1928	[1] 44,270,000	14.0	1934	32,615,831	6.1
1929	[1] 45,840,000	15.1	1935	34,691,330	7.6
1930	[1] 41,320,000	11.9	1936	37,999,606	11.0
1931	[1] 35,869,000	8.1	1937	45,132,333	13.2
1932	31,943,315	4.4	1938	34,602,915	7.8

[1] Amounts for years prior to 1932 estimated on basis of 1932–1938 average relationship between cost and volume (see Table 10).

On Chart 3 have been plotted the depreciation and depletion charges for each of the years against the weighted tonnage shipped. A computation of the line of average relationship by the least squares method referred to above shows that the total depreciation and depletion charges have averaged $29,500,000, plus $2.37 for each weighted ton produced. An inspection of the chart with the line drawn in shows that all of the points fall rather close to the line and deviations that exist are more or less at random and do not seem to be the result of conditions changing with the passage of time. Hence, the actual depreciation and depletion charges for each year have been used without adjustment.

TABLE 12.—*Adjustment of Payroll to 1938 Wage Rates—United States Steel Corporation and Subsidiaries*

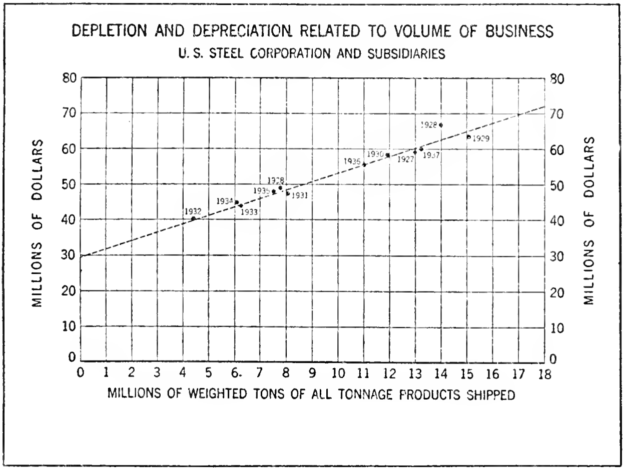
Year	Payroll	Average Hourly Earnings	Ratio of 1938 Average Hourly Earnings to Those of Year of Payroll	Estimated Payroll at 1938 Rates
1927	410,289,135	[1] .682	1.3226	542,648,410
1928	400,000,492	.687	1.3130	525,200,646
1929	406,886,492	.686	1.3149	535,015,048
1930	367,945,736	.687	1.3130	483,112,751
1931	253,178,649	.691	1.3054	330,499,408
1932	131,602,678	.614	1.4691	193,337,494
1933	160,746,223	.596	1.5134	243,273,334
1934	207,564,103	.705	1.2794	265,557,513
1935	246,508,043	.731	1.2339	304,166,274
1936	328,070,724	.737	1.2239	401,525,759
1937	426,330,944	.864	1.0440	445,089,506
1938	275,364,898	.902	1.0000	275,364,898

[1] Estimated.

Wage rates have increased considerably from the low point of the depression and even from the prosperity year of 1929. Hence, the need for adjustment of the payroll figures to 1938 conditions is obvious. This adjustment is shown in Table 12, where the payrolls for each of the respective years are multiplied by the ratio of the 1938 average hourly earnings to the average hourly wage prevailing in the year of the payrolls. Chart 4 shows the relation to volume of the payrolls for each of the respective years adjusted to 1938 wage rates. A line of average relationship has been constructed by the least squares method. An inspection of the chart shows that, in general, payrolls for the later years are lower than what they would have been for the earlier years if 1938 hourly rates had prevailed. This indicates that, to some extent at least, the increases in hourly wage costs have been offset by increased productivity per man hour. Adjustment for this factor has been taken care of, however, by the adjustment for long-term trend in the cost volume relationship which will be discussed later.

Closely connected with the adjustment of payroll is the estimate of social security taxes. These taxes did not exist prior to 1936, and the rates have been

CHART 3



increasing since then. The best method of estimating what the social security taxes would have been for each of the respective years under 1938 conditions would seem to be to take the ratio of the 1938 social security taxes to the 1938 payroll and apply this ratio to the adjusted payroll figures for each of the respective years. In ascertaining the ratio of social security taxes to payroll, the total payroll, including construction payroll, has been used, since the total social security tax paid is based on the entire payroll, including that charged to construction as well as that charged to operations. The payroll figures used in the cost computation, however, consist only of operating payroll and do not include construction payroll, which is properly treated on the books of the Corporation as a capital expenditure. The estimated amount of social security taxes for each of the respective payroll figures is shown in Table 13.

The classification "other expenses" shown in the breakdown of total costs is simply the residual amount after deducting each of the other components. It is impossible to obtain a satisfactory breakdown of this item because, in order to keep the costs of different operations and products properly segregated, the accounts of the United States Steel Corporation are classified on an entirely

different basis from that used in this study. "Other expenses" does consist, however, largely of goods and services purchased from others, including freight paid for transporting materials, although freight paid on shipments of finished goods to customers is treated as a deduction from sales. To some extent at least, therefore, these expenses have been affected from year to year by changes in the commodity price levels.

TABLE 13.—*Estimate of Social Security Taxes at 1938 Rates—United States Steel Corporation and Subsidiaries*

[1938 Social Security Tax ÷ Total 1938 Payroll[1] = 1938 Average Rate
$11,309,216 ÷ $282,209,332 = .040074]

Year	Payroll at 1938 Wage Rates	Social Security Taxes at 1938 Rates	Year	Payroll at 1938 Wage Rates	Social Security Taxes at 1938 Rates
1927	$542, 648, 410	$21, 746, 092	1933	$243, 273, 334	$9, 748, 932
1928	525, 200, 646	21, 046, 891	1934	265, 557, 513	10, 641, 952
1929	535, 015, 042	21, 440, 193	1935	304, 166, 274	12, 189, 159
1930	483, 112, 751	19, 360, 260	1936	401, 523, 759	16, 090, 743
1931	330, 499, 408	13, 244, 433	1937	445, 089, 506	17, 836, 517
1932	193, 337, 494	7, 747, 807	1938	275. 364, 898	11, 034, 973

[1] Including Construction Payroll.

It might be said that no adjustment should be made for the changing prices of materials and services purchased on the theory that such prices are generally lower when steel production is low and higher in periods of prosperity when steel production is high, and that a computation of the relation of volume to cost should include the normally expected change in material prices. However, it was felt that it was advisable to make a broad general adjustment which would roughly eliminate the effect of the low prices which prevailed in the low volume years for the following reasons:

1. The purpose of the study is to ascertain the extent to which a price decrease as of 1938 could be compensated for by increased volume as distinguished from reducing wage rates, or having the benefit of reduced material costs, either of which would permit of some reduction in the price of steel.
2. Comparison of the "other expenses" for 1931, 1935 and 1938, three years of approximately similar volume, shows that under 1938 conditions prices of materials did not decline as much as they formerly did when steel operations were low.
3. An arbitrary reduction in steel prices, the advisability of which is being considered in this study, would be less likely to be accompanied by a decline in material prices than would a decline in steel prices brought about by natural economic forces.
4. Adjustment for material price changes tends to raise the cost figures for the low volume years, thus decreasing the slope of the total cost line and increasing the estimate of the extent to which increased volume would decrease unit costs. Hence, adjustment rather than nonadjustment presents a case more favorable to the critics of steel prices.

On the other hand, since many of the things the Corporation must purchase did not drop in price to the same extent that commodities in general did, overadjustment had to be avoided. The basis of adjustment used has been the U. S. Bureau of Labor Statistics index of wholesale commodity prices other than farm and food products. In order not to overadjust, only half of the "other expense" items have been adjusted by multiplying them by the ratio of the 1938 index to the index prevailing in the year in which the "other expenses" were incurred. To the half of the "other expenses" thus adjusted has been added the remaining half without adjustment. The calculation of the adjustment and the final adjusted figures are shown in Table 14.

CHART 4

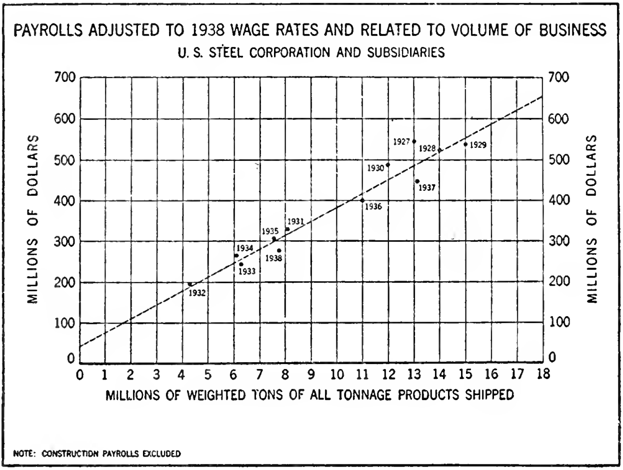


TABLE 14.—*"Other Expenses" Adjusted for Changes in Price Level—United States Steel Corporation and Subsidiaries*

(A) Millions of Weighted Tons of Products Shipped	(B) Year	(C) "Other Expenses" Unadjusted	(D) 50% of Other Expenses	(E) Price Index [1]	(F) Ratio 1938 Index to That of Year of Costs	(G) 50% of Costs Adjusted for Price Change (D×F)	(H) Adjusted "Other Expense" (D+G)
4.4	1932	145, 141, 635	72, 570. 818	70. 4	1. 1605	84, 218, 434	156, 789, 252
6.1	1934	145, 829, 074	72, 914, 537	78. 4	1. 0421	75, 984, 239	148, 898, 776
6.2	1933	164, 492, 120	82, 246, 060	71. 2	1. 1475	94, 377, 354	176, 623. 414
7.6	1935	197, 911, 220	98, 955, 610	77. 9	1. 0488	103, 784, 644	202, 740, 254
7.8	1938	228, 718, 329	114, 359, 165	81. 7	1. 0000	114, 359, 165	228, 718, 330
8.1	1931	195, 028, 995	97, 514, 498	75. 0	1. 0893	106, 222, 543	203, 737, 041
11.0	1936	293, 599, 768	146, 799, 884	79. 6	1. 0264	150, 675, 401	297, 475, 285
11.9	1930	252, 925, 996	126, 462, 998	85. 2	0. 9589	121, 265, 369	247, 728, 367
13.0	1927	334, 512, 051	167, 256, 026	94. 0	0. 8691	145, 362, 212	312, 618, 238
13.2	1937	343, 494, 434	171, 747, 217	85. 3	0. 9578	164, 499, 484	336, 246, 701
14.0	1928	352, 602, 172	176, 301, 086	92. 9	0. 8794	155, 039, 175	331, 340, 261
15.1	1929	353, 855, 986	176, 927, 993	91. 6	0. 8919	157, 802, 077	334, 730, 070
Total		3, 008, 111, 780	1, 504, 055, 892			1, 473, 590, 097	2, 977, 645, 989

[1] B. L. S. Index of Wholesale Prices—all commodities except food and farm products.

TABLE 15.—*Costs Adjusted to 1938 Interest, Tax, Pension, and Wage Rates and 1938 Price Levels, But Unadjusted for Secular Trend—United States Steel Corporation and Subsidiaries*

Millions of Weighted Tons of Products Shipped	Year	Interest [1]	Taxes Other than Social Security and Federal Income	Pensions [3]	Depreciation and Depletion	Payroll [4]	Social Security Taxes [5]	Other Expenses [6]	Total Costs
4.4	1932	8, 262, 327	31, 943, 315	7, 743, 046	40, 319, 794	193, 337, 494	7, 747, 807	156, 789, 252	446, 143, 035
6.1	1934	8, 262, 327	32, 615, 831	7, 743, 046	44, 579, 309	265, 557, 513	10, 641, 952	148, 898, 776	518, 298, 754
6.2	1933	8, 262, 327	33, 288, 485	7, 743, 046	43, 584, 499	243, 273, 234	9, 748, 932	176, 623, 414	522, 523, 937
7.6	1935	8, 262, 327	34, 691, 330	7, 743, 046	47, 801, 389	304, 166, 274	12, 139, 159	202, 740, 254	617, 593, 779
7.8	1938	8, 262, 327	34, 602, 915	7, 743, 046	48, 532, 841	275, 364, 898	11, 034, 973	228, 718, 330	614, 259, 330
8.1	1931	8, 262, 327	[2] 35, 869, 000	7, 743, 046	47, 317, 895	330, 499, 408	13, 244, 433	203, 737, 041	646, 673, 150
11.0	1936	8, 262, 327	37, 999, 606	7, 743, 046	55, 466, 762	401, 525, 759	16, 090, 743	297, 475, 285	824, 563, 528
11.9	1930	8, 262, 327	[2] 41, 320, 000	7, 743, 046	58, 550, 120	483, 112, 751	19, 360, 260	247, 728, 367	866, 076, 871
13.0	1927	8, 262, 327	[2] 42, 859, 000	7, 743, 046	58, 906, 007	542, 648, 410	21, 746, 092	312, 618, 238	994, 783, 120
13.2	1937	8, 262, 327	45, 132, 333	7, 743, 046	59, 589, 159	445, 089, 506	17, 836, 517	336, 246, 701	919, 899, 589
14.0	1928	8, 262, 327	[2] 44, 270, 000	7, 743, 046	67, 237, 303	525, 200, 646	21, 046, 891	331, 340, 261	1, 005, 100, 474
15.1	1929	8, 262, 327	[2] 45, 840, 000	7, 743, 046	63, 274, 163	535, 015, 048	21, 440, 193	334, 730, 070	1, 016, 304, 847
Total		99, 147, 924	460, 431, 815	92, 916, 552	635, 159, 241	4, 544, 790, 941	182, 127, 952	2, 977, 645, 989	8, 992, 220, 414

[1] As paid in 1938.
[2] Estimated under present rates (see Table 10).
[3] As paid in 1938.
[4] Actual payroll adjusted to 1938 average hourly earnings.
[5] 1938 percentage of payroll, 4.0074%, applied to adjusted payroll for each year. Excludes social security taxes allocable to construction payroll.
[6] Adjusted for changes in general price level as indicated by Bureau of Labor Statistics Index of Wholesale Prices of all commodities other than food and farm products, on the assumption that 50% of items are affected by general price changes.

In Table 15 the various components of cost for each of the respective years adjusted to 1938 interest, tax, pension and wage rates and to 1938 price levels have been added together to give total cost figures. These total cost figures represent what would have been the cost for the volume sold in each of the respective years if 1938 conditions of wages, interest, taxes, pensions and prices had prevailed. These total costs, however, do not take into consideration the long-term downward trend of costs in relation to volume due to changes in methods of production within the industry itself and hence do not quite represent what the cost would have been if the same volume had been sold in 1938. An instance of this was referred to in connection with the adjustment of payrolls where it was seen that the payrolls for earlier years would have been greater in relation to volume produced than present-day payrolls if present-day hourly rates were paid. Hence it became necessary to make a further adjustment of total costs for any general increase in efficiency and other changes in operating conditions that may have taken place during the period.

TABLE 16.—*Deviation of Adjusted Total Costs*[1] *from Average Costs for Volume Involved—United States Steel Corporation and Subsidiaries*

Year	Millions of Weighted Tons of Products Shipped	Actual Adjusted Costs	Average Adjusted Costs for Volume[2]	Deviation	Deviation as Percentage of Average Cost
1932	4.4	446.1	429.7	+16.4	+3.8
1934	6.1	518.3	529.1	−10.8	−2.0
1933	6.2	522.5	535.0	−12.5	−2.3
1935	7.6	617.6	616.8	+0.8	+0.1
1938	7.8	614.3	628.5	−14.2	−2.3
1931	8.1	646.7	646.1	+0.6	+0.1
1936	11.0	824.6	815.6	+9.0	+1.1
1930	11.9	866.1	868.2	−2.1	−0.2
1927	13.0	994.8	932.5	+62.3	+6.7
1937	13.2	919.9	944.2	−24.3	−2.6
1928	14.0	1005.1	991.0	+14.1	+1.4
1929	15.1	1016.3	1055.3	−39.0	−3.7

[1] Total costs adjusted to 1938 interest, tax, pension, and wage rates and to 1938 price levels.
[2] As indicated by line of average relationship, Chart 5.

In Chart 5 the total costs adjusted to 1938 interest, tax, pension and wage rates and 1938 price levels are plotted against the number of weighted tons shipped. The line of average relationship computed by the least squares method has been drawn upon the graph. In Table 16 have been set forth the actual adjusted costs and next to them have been placed what those total costs would have amounted to for the same volume if they were actually located on the line. In the third column the deviations or differences between the two are set down, and in the fourth column, the deviations are reduced to percentages of the average cost for the volume in question as indicated by the line of average relationship. These percentage deviations are plotted by years on Chart 6. An inspection of this chart will show that many of the deviations are more or less at random, but that to a certain extent costs in later years tend to be lower than average, while costs in earlier years tend to be higher. This general trend, computed mathematically by the least squares method, shows the extent to which the deviations from the average are correlated with the passage of time. The computation shows that costs tended to be 2.17% above average at the beginning of the period and 2.15% below average at the end. Thus the gradual increase in efficiency in the eleven years preceding 1938 has been associated with a total drop in costs roughly equal to 4.32% of average costs. This represents an average decrease in costs equal to .393% of average costs per years. Thus, the costs under 1938 conditions can be estimated by subtracting from the actual adjusted costs for any particular year the amount of the average cost for that year's volume multiplied by .00393 times the number of years intervening between the year in which the costs were incurred and 1938. This adjustment is shown in Table 17.

CHART 5

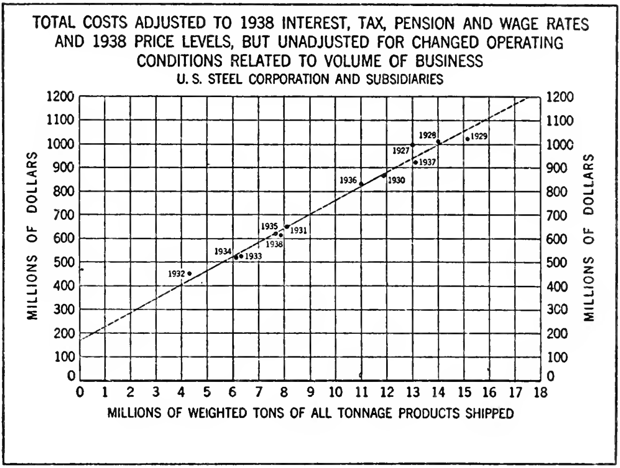


CHART 6

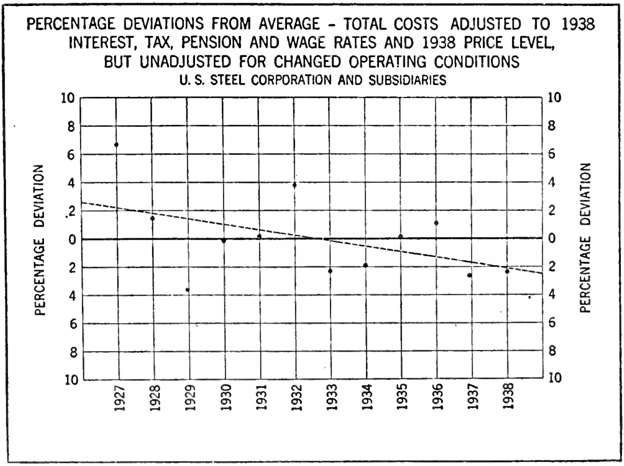


TABLE 17.—*Adjustment of Total Costs*[1] *for Time Trend—United States Steel Corporation and Subsidiaries*

A	B	C	D	E	F	G	H
Year	Millions of Weighted Tons of Products Shipped	Average Adjusted Costs for Volume[2]	Years Prior to 1938	Fractional Decrease (.00393×D)	Adjustment (C×E)	Actual Adjusted Costs	Final Adjusted Costs (G−F)
1927	13.0	932.5	11	.04323	40.3	994.8	954.5
1928	14.0	991.0	10	.03930	38.9	1,005.1	966.2
1929	15.1	1,055.3	9	.03537	37.3	1,016.3	979.0
1930	11.9	868.2	8	.03144	27.3	866.1	838.8
1931	8.1	646.1	7	.02751	17.8	646.7	628.9
1932	4.4	429.7	6	.02358	10.1	446.1	436.0
1933	6.2	535.0	5	.01965	10.5	522.5	512.0
1934	6.1	529.1	4	.01572	8.3	518.3	510.0
1935	7.6	616.8	3	.01179	7.3	617.6	610.3
1936	11.0	815.6	2	.00786	6.4	824.6	818.2
1937	13.2	944.2	1	.00393	3.7	919.9	916.2
1938	7.8	628.5	0	.00000	0.0	614.3	614.3

[1] Total costs adjusted to 1938 interest, tax, pension, and wage rates and to 1938 price levels.
[2] As indicated by line of average relationship, Chart 5.

The resulting adjusted cost figures thus represent the original costs for each of the years from 1927 to 1938, adjusted to 1938 interest, tax, pension and wage rates, to 1938 price levels and to 1938 general efficiency. The final adjusted figure for 1938 is, as it should be, the same as the unadjusted figure for that year, except that the social security taxes allocable to construction payroll have been eliminated. Table 18 sets forth these costs in relation to volume. The figures are plotted on Chart 7. A computation of the line of average relationship fitted to these points by the least squares method shows that the normal relation of costs to volume under 1938 conditions is $55.73 per weighted ton shipped, plus $182,100,000, as was stated in the summary. The smallness of the deviations of the actual costs, adjusted to 1938 conditions, from the normal cost line shows the faithfulness with which the Corporation's costs follow this pattern.

TABLE 18.—*Total Costs of Operation and Volume of Business—1938 Conditions*[1]*—United States Steel Corporation and Subsidiaries*

Millions of Weighted Tons of Products Shipped	Costs, 1938 Conditions	Year on which Estimate Based	Millions of Weighted Tons of Products Shipped	Costs, 1938 Conditions	Year on which Estimate Based
4.4	436.0	1932	11.0	818.2	1936
6.1	510.0	1934	11.9	838.8	1930
6.2	512.0	1933	13.0	954.5	1927
7.6	610.3	1935	13.2	916.2	1937
7.8	614.3	1938	14.0	966.2	1928
8.1	628.9	1931	15.1	979.0	1929

[1] Total costs adjusted to 1938 interest, pension, wage and tax rates, to 1938 price levels, and to 1938 efficiency.

IV. COMPOSITION OF COSTS

If it were not for the fact that the total costs obtained by adding together the adjusted components of cost that were developed in connection with the derivation of the total cost pattern had to be adjusted for the gradual increase in efficiency and other changes in conditions over the period, it would be possible to obtain a breakdown of the fixed and variable total costs simply by listing the fixed and variable elements of the various adjusted components. Since the total costs were adjusted for these changes in operating conditions as indicated by the long-term trend in the cost-volume relationship, an approximate breakdown could be made only by making a similar adjustment for time trend for each of the individual components in which a time trend exists.

Since the 1938 amounts of interest and pensions were used for all volumes, no time trend adjustment had to be made with regard to these items. An inspection of the movement of taxes and of depreciation and depletion with increases in volume, as shown on Charts 2 and 3 respectively, reveals that no appreciable time trend exists with regard to these items. The social security taxes will vary directly with any adjustments that are made in the payroll figure. It is apparent that the bulk of the adjustment made in the total cost figures for time trend arose from the time trends involved in the payroll and "other expense" items. Clearly, then, it was these two items which had to be adjusted for time trend in order to obtain an approximate breakdown of total costs.

Chart 4 shows the payroll for each of the various years adjusted to 1938 wage rates and plotted against the volume of goods shipped in the year in which the payroll was incurred. An inspection of this chart shows that, with the exception of 1929, the payrolls in earlier years, would have been greater in relation to volume than the payrolls in 1937 and 1938, if 1938 wage scales had been in effect. In Table 19 the deviations of the adjusted payrolls for each of the years from the average payroll for the volume involved, as indicated by the line of average relationship on Chart 4, are computed. Also shown are the percentages by which the actual payrolls, adjusted to 1938 wage rates, are in excess of or less than the average payroll for the rate of operations. On Chart 8 these percentage deviations are plotted by years.

TABLE 19.—*Deviation of Payrolls, Adjusted to 1938 Wage Rates, from Average Payroll for Volume Involved—United States Steel Corporation and Subsidiaries*

Year	Millions of Weighted Tons of Products Shipped	Actual Payroll Adjusted to 1938 Rates	Average Adjusted Payroll for Volume [1]	Deviation	Deviation as Percentage of Average
1932	4.4	193.3	192.4	+0.9	+0.5
1934	6.1	265.6	250.3	+15.3	+6.1
1933	6.2	243.3	253.7	−10.4	−4.1
1935	7.6	304.2	301.5	+2.7	+0.9
1938	7.8	275.4	308.3	−32.9	−10.7
1931	8.1	330.5	318.5	+12.0	+3.8
1936	11.0	401.5	417.4	−15.9	−3.8
1930	11.9	483.1	448.0	+35.1	+7.8
1927	13.0	542.6	485.5	+57.1	+11.8
1937	13.2	445.1	492.3	−47.2	−9.6
1928	14.0	525.2	519.6	+5.6	+1.1
1929	15.1	535.0	557.1	−22.1	−4.0

[1] As indicated by line of average relationship, Chart 4.

It is apparent from the chart that there has been some decline with the passage of time in the amount of labor required to produce a given quantity of steel. Computation of the least squares trend shows the extent to which the deviations from the average are correlated with the passage of time. As indicated on the chart, payrolls tended to be 7.19% above average in 1927 as compared to 7.22% below average in 1938. This represents a gradual increase in productivity per man-hour during the eleven years preceding 1938 that has resulted in a decrease in the payroll required for any given volume at 1938 wage rates equivalent to 14.41% of the average payroll for that volume. This amounts to an average decrease in payroll of 1.31% of average payroll per year. Thus the payroll under 1938 conditions can be estimated by subtracting from the actual payroll for any particular year, adjusted to 1938 wage rates, the amount of the average adjusted payroll for that year's volume, multiplied by .0131 times the number of years intervening between the year in which the payroll was paid and 1938. This adjustment is shown in Table 20.

CHART 7

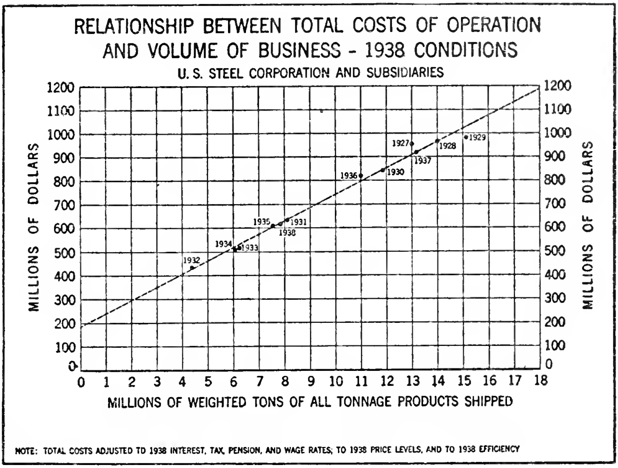


CHART 8

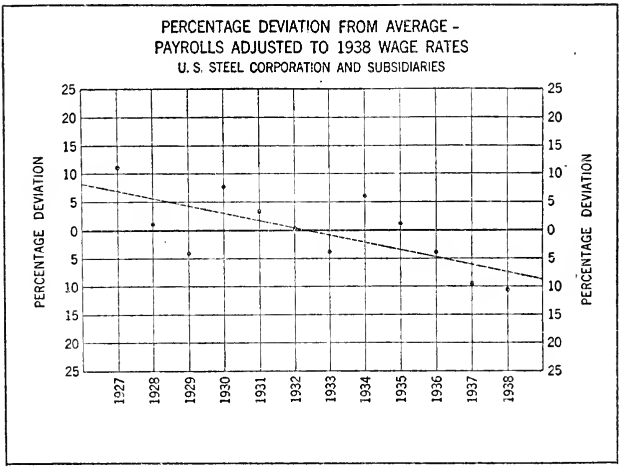


TABLE 20.—*Adjustment of Payrolls, Adjusted to 1938 Wage Rates, for Time Trend—United States Steel Corporation and Subsidiaries*

(A) Year	(B) Millions of Weighted Tons of Products Shipped	(C) Average Adjusted Payroll for Volume[1]	(D) Years Prior to 1938	(E) Fractional Decrease (.013098 ×D)	(F) Adjustment (C×E)	(G) Actual Adjusted Payrolls	(H) Final Adjusted Payroll (G−F)
1927	13.0	485.5	11	.144078	69.9	542.6	472.7
1928	14.0	519.6	10	.130980	68.1	525.2	457.1
1929	15.1	557.1	9	.117882	65.7	535.0	469.3
1930	11.9	448.0	8	.104784	46.9	483.1	436.2
1931	8.1	318.5	7	.091686	29.2	330.5	301.3
1932	4.4	192.4	6	.078588	15.1	193.3	178.2
1933	6.2	253.7	5	.065490	16.6	243.3	226.7
1934	6.1	250.3	4	.052392	13.1	265.6	252.5
1935	7.6	301.5	3	.039294	11.8	304.2	292.4
1936	11.0	417.4	2	.026196	10.9	401.5	390.6
1937	13.2	492.3	1	.013098	6.4	445.1	438.7
1938	7.8	308.3	0	.000000	0.0	275.4	275.4

[1] As indicated by line of average relationship, Chart 4.

TABLE 21.—*Payrolls, Adjusted to 1938 Wage Rates and Efficiency, Related to Volume of Business—United States Steel Corporation and Subsidiaries*

Millions of Weighted Tons of Products Shipped	Payroll—1938 Conditions	Year on which Estimate Based	Millions of Weighted Tons of Products Shipped	Payroll—1938 Conditions	Year on which Estimate Based
4.4	178.2	1932	11.0	390.6	1936
6.1	252.5	1934	11.9	436.2	1930
6.2	226.7	1933	13.0	472.7	1927
7.6	292.4	1935	13.2	438.7	1937
7.8	275.4	1938	14.0	457.1	1928
8.1	301.3	1931	15.1	469.3	1929

In Table 21 are shown the payrolls, at 1938 wage rates and at 1938 efficiency as indicated by the time trend adjustments, for each of the various tonnages shipped during the 1927–1938 period. On Chart 9 these final adjusted payroll figures are plotted in relation to volume. A straight line, fitted to the points by the least squares method, indicates that the total payroll under 1938 conditions will amount to $62,100,000 plus $29.10 per weighted ton of product shipped.

TABLE 22.—*Deviation of Adjusted[1] "Other Expenses" From Average for Volume Involved—United States Steel Corporation and Subsidiaries*

Year	Millions of Weighted Tons of Products Shipped	Actual "Other Expenses" Adjusted for Price	Average "Other Expenses" for Volume Involved[2]	Deviation	Deviation as Percentage of Average
1932	4.4	156.8	143.1	+13.7	+9.6
1934	6.1	148.9	175.8	−26.9	−15.3
1933	6.2	176.6	177.7	−1.1	−0.6
1935	7.6	202.7	204.6	−1.9	−0.9
1938	7.8	228.7	208.4	+20.3	+9.7
1931	8.1	203.7	214.2	−10.5	−4.9
1936	11.0	297.5	269.9	+27.6	+10.2
1930	11.9	247.7	287.2	−39.5	−13.8
1927	13.0	312.7	308.3	+4.4	+1.4
1937	13.2	336.3	312.2	+24.1	+7.7
1928	14.0	331.4	327.6	+3.8	+1.2
1929	15.1	334.8	348.7	−13.9	−4.0

[1] "Other Expenses" adjusted for changes in the general price level as indicated by the B. L. S. index of wholesale prices for commodities other than food and farm products assuming 50% of items affected.
[2] As indicated by line of average relationship, Chart 10.

CHART 9

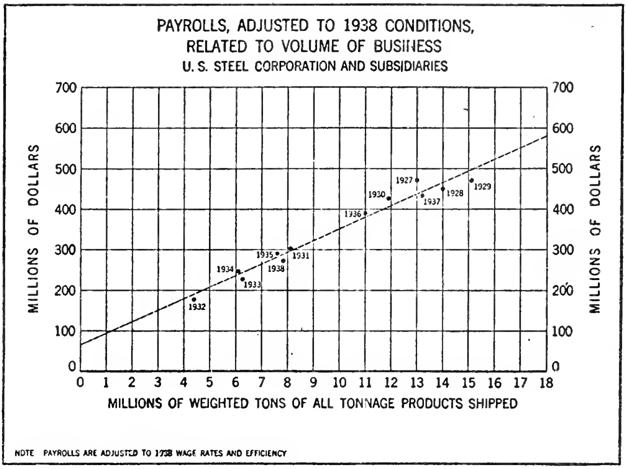
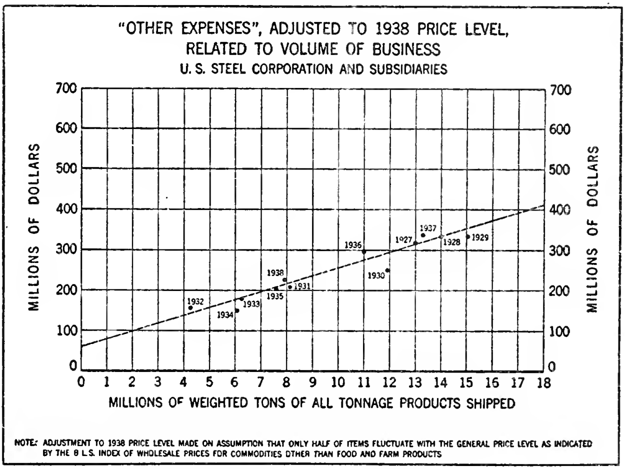


CHART 10



A similar time trend computation and adjustment has been made with regard to the item "other expenses." Chart 10 shows the "other expense" items adjusted for changes in the general price level, as per Table 14. The computation of the average relationship shows that these cost items tend to amount to $58,600,000 plus $19.21 per weighted ton of product shipped. The deviations from this line are in some instances fairly large and in general it would appear that "other expenses" tended to be below average in the earlier years and above average toward the end of the 1927–1938 period. In Table 22 are shown the deviations and the percentage deviations from average of the "other expense" items adjusted for price changes. Chart 11 shows the percentage deviations, plotted by years. Computation of the general trend shows that they are correlated with the passage of time in such a way that "other expenses" at 1938 price levels tend to be 5.21% below average in 1927, as against 5.26% above average in 1938, representing an increase over the eleven year period prior to 1938 amounting to 10.47% of average, or .95% of average per year. The adjustment of the figures for each of the respective years for this time trend is made in Table 23. In Table 24 the final adjusted figures are shown in connection with the volume of shipments involved. In Chart 12 the "other expense" items, adjusted for both price changes and time trend, are shown in relation to volume. Computation of the line of average relationship shows that under 1938 conditions "other expenses" tend to amount to $21.40 per weighted ton plus $50,900,000.

TABLE 23.—*Adjustment of Adjusted "Other Expenses" for Time Trend—United States Steel Corporation and Subsidiaries*

(A) Year	(B) Millions of Weighted Tons of Products Shipped	(C) Average Adjusted "Other Expenses" [1]	(D) Years Prior to 1938	(E) Fractional Increase (.009521× D)	(F) Adjustment (C×E)	(G) Actual Adjusted "Other Expenses"	(H) Final Adjusted "Other Expenses" (G+F)
1927	13.0	308.3	11	.104731	32.3	312.7	345.0
1928	14.0	327.6	10	.095210	31.2	331.4	362.6
1929	15.1	348.7	9	.085689	29.9	334.8	364.7
1930	11.9	287.2	8	.076168	21.9	247.7	269.6
1931	8.1	214.2	7	.066647	14.3	203.7	218.0
1932	4.4	143.1	6	.057126	8.2	156.8	165.0
1933	6.2	177.7	5	.047605	8.5	176.6	185.1
1934	6.1	175.8	4	.038084	6.7	148.9	155.6
1935	7.6	204.6	3	.028563	5.8	202.7	208.5
1936	11.0	269.9	2	.019042	5.1	297.5	302.6
1937	13.2	312.2	1	.009521	3.0	336.3	339.3
1938	7.8	208.4	0	.000000	0.0	228.7	228.7

[1] For volume involved, as indicated by line of average relationship, Chart 10.

TABLE 24.—*"Other Expenses", Adjusted to 1938 Price Levels and Operating Conditions, Related to Volume of Business—United States Steel Corporation and Subsidiaries*

Millions of Weighted Tons of Products Shipped	Other Expenses—1938 Conditions	Year on which Estimate Based	Millions of Weighted Tons of Products Shipped	Other Expenses—1938 Conditions	Year on which Estimate Based
4.4	165.0	1932	11.0	302.6	1936
6.1	155.6	1934	11.9	269.6	1930
6.2	185.1	1933	13.0	345.0	1927
7.6	208.5	1935	13.2	339.3	1937
7.8	228.7	1938	14.0	362.6	1928
8.1	218.0	1931	15.1	364.7	1929

CHART 11

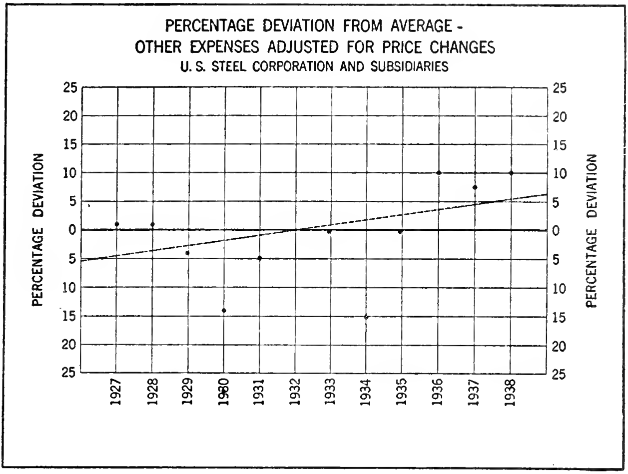
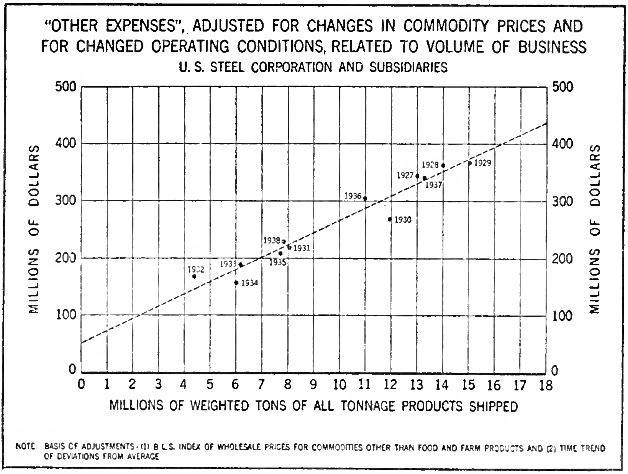


CHART 12



Adding together the fixed and variable elements of the final adjusted components of cost gives the following result:

TABLE 25.—*Elements of Total Costs Adjusted to 1938 Conditions*—United States Steel Corporation and Subsidiaries*

Item	Fixed	Variable
Interest	$8, 300, 000	$0. 00 per ton
Pensions	7, 700, 000	0. 00 " "
Taxes	24, 200, 000	1. 43 " "
Depreciation and Depletion	29, 500, 000	2. 37 " "
Payroll	62, 100, 000	29. 10 " "
Social Security	2, 500, 000	1. 16 " "
Other Expenses	50, 900, 000	21. 40 " "
Total Costs	$185, 200, 000	$55. 46 per ton

* Elements of cost individually adjusted to 1938 interest, tax, pension, and wage rates; to 1938 price levels; and for time trend.

The total fixed and variable costs obtained by this calculation are thus seen to be substantially the same as the results obtained by adjusting total costs, instead of the individual components, for time trend. It would seem that the time trend adjustment made with respect to total costs would represent the more accurate figure of the two. First of all, it includes any slight time trends that may exist with regard to the other components. Secondly, as has already been mentioned in connection with the discussion of the derivation of the total cost curve, the payroll figures are not comparable with shipments to the extent that production is greater or less than shipments. Consequently some of the deviations on which the payroll time trend was estimated may be the result of inventory fluctuations. Similarly, since the "other expense" classification was simply the residual amount after deducting from total costs the other components of cost, the amount of this item for each year has been overstated to the same extent that payroll has been understated, or vice versa, because of inventory fluctuations, and some of the deviations on which the "other expense" time trend was computed may also have been the result of the inventory situation. Since total costs were extracted from the profit and loss statements and represent the sum of any offsetting errors in "other expenses" and payroll, they are comparable with shipments and the deviations cannot be attributed to inventory fluctuations, except to the minute extent that the situation just described resulted in payroll adjustments being applied to a small portion of costs which should have been classified as "other expense," and vice versa.

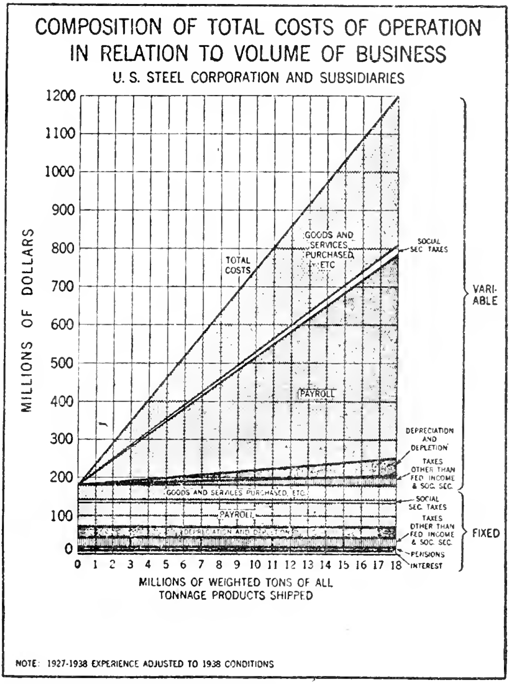
Assuming, then, that the total costs of $182,100,000 plus $55.73 per weighted ton of product shipped, developed by adjusting total costs for time trend, represents the more accurate figure, the approximation of the components of total costs under 1938 conditions may be revised as follows:

TABLE 26.—*Elements of Total Costs—Revised 1938 Conditions—United States Steel Corporation and Subsidiaries*

Item	Fixed	Variable
Interest	$8, 300, 000	$0. 00 per ton
Pensions	7, 700, 000	0. 00 " "
Taxes other than Social Security and Federal Income	24, 200, 000	1. 43 " "
Depreciation and Depletion	29, 500, 000	2. 37 " "
Payroll	62, 100, 000	29. 10 " "
Social Security Taxes	2, 500, 000	1. 16 " "
Other Expenses	47, 800, 000	21. 67 " "
Total Costs	$182, 100, 000	$55. 73 per ton

The entire adjustment has been made in the "other expense" figures because the adjustment does not involve a relatively large amount in any event, and because the "other expense" classification represents a conglomeration of items and is the least accurate classification anyhow. Chart 13 graphically portrays the relation of the various elements of cost to volume. The differences between the two estimates of fixed and variable costs shown above are so small that the

CHART 13



graphing of either upon the chart would show the same result. The "other expense" item has been labeled "goods and services purchased, etc." on the chart to indicate its general nature.

Segregating the cash from the non-cash items, the cost pattern of the Corporation under 1938 conditions is as follows:

TABLE 27.—*Cash and Non-Cash Costs 1938 Conditions—United States Steel Corporation and Subsidiaries*

Item	Fixed	Variable
Interest	$8,300,000	$0.00 per ton
Pensions	7,700,000	0.00 " "
Taxes other than Social Security and Federal Income	24,200,000	1.43 " "
Payroll	62,100,000	29.10 " "
Social Security Taxes	2,500,000	1.16 " "
Other Cash Expenses	47,800,000	21.67 " "
Total Cash Costs	152,000,000	53.36 per ton
Depreciation and Depletion	29,500,000	2.37 " "
Total Costs	$182,100,000	$55.73 per ton

The question frequently arises as to what portion of the total costs of the United States Steel Corporation represents fixed costs and what portion represents variable costs. These percentages will differ, of course, with the volume of shipments, because by definition, fixed costs remain the same regardless of the quantity produced, while variable costs increase with each additional ton of product. The percentages of fixed to total costs at various operating rates are shown in Table 28. The computation and significance of the "Average Equivlent Percentage of Unweighted Rolled and Finished Capacity" shown in the table are explained in Section VI, "Weighted Tonnages and the Operating Rate."

TABLE 28.—*Percentage of Fixed to Total Costs at Various Rates of Operation—1938 Conditions—United States Steel Corporation and Subsidiaries*

[Total costs = $55.734 per weighted ton of product shipped + $182,100,000. Fixed costs = $182,100,000]

Millions of Weighted Tons of Products Shipped	Average Equivalent Percentage of Unweighted Rolled and Finished Capacity (See Table 37)	Fixed Costs (Millions of Dollars)	Total Costs (Millions of Dollars)	Percentage Fixed to Total
2.45	10	182.1	318.6	57.2
4.17	20	182.1	414.5	43.9
5.87	30	182.1	509.3	35.8
7.59	40	182.1	605.1	30.1
9.30	50	182.1	700.4	26.0
11.00	60	182.1	795.2	22.9
12.72	70	182.1	891.0	20.4
14.43	80	182.1	986.3	18.5
16.14	90	182.1	1081.6	16.8
17.85	100	182.1	1177.0	15.4

V. Relation of Costs and Volume to Prices

Knowing the relation between volume and total cost, it becomes important to determine the way in which decreased prices fit into the picture. To determine whether price reductions would pay or would involve prohibitive losses, it is necessary to compare the increase in volume and the total revenues which might be anticipated if prices were reduced with the total costs of producing the tonnage involved. The Corporation's shipments could be increased through price reduction, if at all, only by increasing the total amount of steel consumed, since competitive meeting of prices by other producers would prevent increased participation in the going volume of business. It is important to bear in mind that the rise to be expected in the total volume of steel consumed as a result of a drop in prices is not very great in the steel industry. Steel is not sold directly to the ultimate consumer. It reaches him only as a part of the finished automobile, refrigerator, typewriter, apartment house, tin can, or safety pin, as the case may be. In other cases, steel is used only as part of the machinery and equipment used in making the products which reach the man in the street. No matter how low the price, steel can be sold only if products which are produced from steel or by the use of steel are being sold. In the case of products produced from steel, the cost of the steel is usually so small a fraction of the total cost of the product that a reduction in steel prices, even if passed on to the ultimate consumer, would not result in a sufficient decrease in the price of the finished product to cause an appreciable increase in its sale. As far as steel for production equipment is concerned, it goes without saying that regardless of the price of steel no one will invest in productive machinery unless he feels the prospects in this particular line of business justify such investment.

Analysis of the influence of price as a factor affecting steel consumption in the automobile, railroad and container industries reveals that a decrease in the price of steel can increase the consumption of steel only to a limited extent by promoting the use of more steel per unit or permitting steel to be substituted for some other competing material. Any substantial increase in the consumption of steel in these industries could be brought about only by increasing the consumption of the finished product or service rendered. Consequently, the price elasticity of the demand for steel depends primarily upon the price elasticity of demand for the finished product and the relative cost of steel to the price of the finished product. The elasticity of demand is measured by the ratio of the relative resulting increase

in volume to the relative decrease in price. For example, in the case of automobiles, an exhaustive study by Messrs. Roos and von Szeliski [4] found that the price elasticity of demand for automobiles was about 1.5, which means that a 1% reduction in price would increase the number of automobiles sold about 1.5%. Since the cost of steel in the form sold by the steel producers is about one-tenth of the retail price of a representative low-priced automobile, it follows that a reduction of 10% in the price of steel, even if the saving in cost is passed on to the ultimate consumer, can effect at most only a 1% reduction in the price of the delivered automobile. A price reduction of that amount, as has been stated, could bring about but a 1.5% increase in the number of automobiles sold and in the amount of steel used in the automobile industry. The increased consumption arising out of the extent to which steel might be substituted for some other material, or the extent to which the use of steel per automobile might be increased if steel prices were reduced, would probably not increase the elasticity by more than .1. Taking into account all factors and making a liberal allowance for possible error, the elasticity of demand for automotive steel is not in excess of .2 or .3.

The price elasticities for the finished products or services in the container and railroad industries have not had the benefit of as definite measurement as that made of the demand for automobiles by Messrs. Roos and von Szeliski, but the evidence indicates that the demand for these products is considerably less elastic than the demand for automobiles. Moreover, analyses of all the factors influencing steel consumption in these industries, even assuming an elasticity of demand for the finished products and services as high as 2, show definitely that the price elasticity of the demand for steel in each of the respective industries is considerably less than 1. A mathematical analysis of the correlation between the amount of all steel sold and the various factors, including price, which influence the quantity sold, reveals that a negligible portion of the fluctuations in the quantity sold are attributable to price and that a steel price change, other factors remaining unchanged, will not result in as great a percentage change in the volume of steel sold. This confirms the individual analyses of the principal steel consuming industries already mentioned.

While the above analyses indicate clearly that the elasticity of the demand for steel is considerably less than 1, it has been assumed for the purposes of this study, in order to use a figure that is beyond question, that the elasticity of demand for steel is as high as 1. An elasticity of 1 means that any decrease in price will result in a proportional increase in volume which will keep the total sales in dollars unchanged. This is to say that for small changes in price a given percentage decrease, such as a 5% reduction in price, will result approximately in the same percentage increase in volume sold.[5]

It is evident that unless the elasticity of demand for the product exceeds 1 by a substantial margin, the theory that price reduction in and by itself would produce profits through increased volume is utterly fallacious, not only for the United States Steel Corporation, but for any business or any industry. Since, with the elasticity of demand equalling 1, the total sales receipts would remain the same, for the theory to work the total costs of producing the greater volume would also have to be the same or less. For example, no increased payroll could be incurred to produce the greater volume. Such a condition could exist only when all costs were "fixed" or "overhead" and none were "additional" or "variable." Only then would the cost per unit go down, relatively, as fast as the volume went up. Application of the theory of increased profits through price reduction could thus only produce loss to the enterprise which adopted it. The actual amount to be lost by the United States Steel Corporation through reducing prices, however, and the amount by which the increase in volume to be expected as a result of reducing steel prices falls short of the increase needed to offset the price reduction, can be estimated only by including in the computation the relationship which exists between costs and volume.

The sales of the subsidiaries of the United States Steel Corporation to outside customers, less discounts, returns and allowances, amounted in 1938 to $560,508,-302.96. This amount is net, after deduction of freight paid on shipments to customers. The transportation and miscellaneous revenues, after excluding the estimated amount of inter-company profits, amounted to approximately $45,267,-000. The weighted tonnage of all products shipped amounted to approximately

[4] C. F. Roos and Victor von Szeliski, "Factors Governing Changes in Domestic Automobile Demand," *The Dynamics of Automobile Demand*, General Motors Corporation, N. Y., 1939.
[5] For computation of percentage increases in volume which would result from various percentage decreases in price if elasticity of demand were 1, see Appendix II.

7,800,000 weighted tons. The sales and revenues per weighted ton for 1938, therefore, are made up as follows:

TABLE 29.—*Sales and Other Operating Revenues 1938—United States Steel Corporation and Subsidiaries*

Item	Total (Millions)	Per Weighted Tons of Products Shipped
Sales	$560.508	$71.86
Transportation and miscellaneous revenues	45.267	5.80
Total sales and revenues	$605.775	$77.66

Sales and revenues for 1938 thus averaged $77.66 per weighted ton of tonnage products shipped.

It should be borne in mind, however, that any profit or loss estimates based on these figures suppose 1938 average sales per weighted ton. To the extent that prices are not always proportional to costs, to the extent that some products sell for a higher or lower price than others costing the same to produce, the 1938 average sales per weighted ton is affected by the quantities of each particular product sold, as well as by the prices prevailing. Hence the profit or loss estimates contained in the summary are accurate for 1938 average sales per weighted ton, but different products might be sold in another year which would constitute the same weighted tonnage when weighted on a cost basis, but which would carry different profit margins and thus result in a slightly different average sales per weighted ton figure, although the actual 1938 prices for each product had not changed. The possibility that an over-all price reduction in 1938 would have materially changed the proportion of sales constituted by each type of product would, however, seem rather remote.

Furthermore, in computing the total sales and revenue at various shipment levels, it has been assumed that the revenues from transportation and miscellaneous operations rise and fall approximately as product shipments go up and down. That this has been the general relation of transportation and miscellaneous revenues to the volume of steel and other manufacturing business done may be seen from Chart 14. The data on which this chart is based are given in Table 30. The transportation and miscellaneous revenues, after deducting estimated inter-company items, amounted in 1938 to $5.80 per weighted ton and it is assumed for the purposes of this study that they would increase sufficiently so as still to amount to $5.80 per ton if the volume of products sold were increased. It should be noted, however, that the 1938 transportation and miscellaneous revenues were higher than average in relation to the volume of products shipped and that in recent years there has been a tendency for these revenues to fall off somewhat per ton of product shipped when the higher levels of production are reached, as is indicated by the position of the points for 1930, 1936 and 1937. Hence it is rather likely that at the higher operating rates the total sales and revenues would be silghtly less than estimated in this study. To the extent that transportation and miscellaneous operating revenues might fail to increase proportionately with increases in shipments, the losses entailed through pride reduction would be greater than those described.

CHART 14

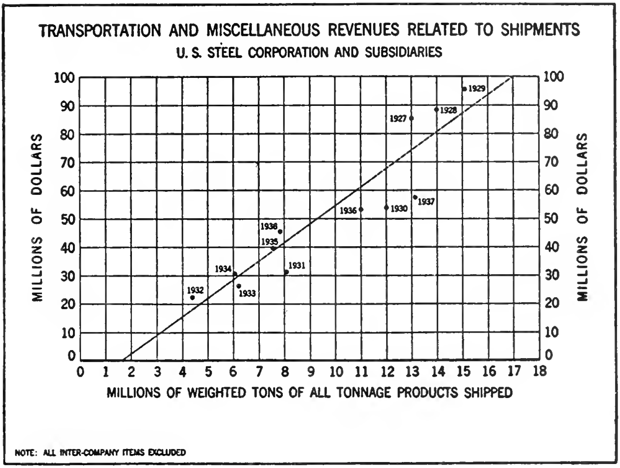


TABLE 30.—*Transportation and Miscellaneous Revenues* [1] *Related to Shipments—United States Steel Corporation and Subsidiaries*

Millions of Weighted Tons of Products Shipped	Year	Net Sales and Revenues (Millions of Dollars)	Net Sales (Millions of Dollars)	Transportation and Miscellaneous (Millions of Dollars)
4.4	1932	283.5	261.7	21.8
6.1	1934	418.5	388.5	30.0
6.2	1933	371.0	345.3	25.7
7.6	1935	539.9	500.8	39.1
7.8	1938	605.8	560.5	45.3
8.1	1931	523.7	488.7	35.0
11.0	1936	791.7	738.5	53.2
11.9	1930	814.4	760.8	53.6
13.0	1927	946.6	861.4	85.2
13.2	1937	1021.6	964.4	57.2
14.0	1928	992.6	903.9	88.7
15.1	1929	1067.8	972.3	95.5

[1] Estimated amount of inter-company items excluded.

On the other hand, the greatest extent to which it is likely that fluctuations in the revenues from transportation and miscellaneous operations per ton of products sold will change the picture presented may be seen from the fact that the transportation and miscellaneous revenues have averaged only 7.5% of total sales and revenues over the period 1927–1938 and that the transportation and miscellaneous revenues per ton of product sold have never in that period amounted to more than 75 cents above or $1.65 below the 1938 figure. The figures for each year, together with the deviations from the 1938 figure, are given in Table 31. The effect of such possible deviations on the profit computations that have been based on these sales and revenue figures is further minimized by the fact that the cost of these operations would also be likely to fall at least partly as much as the revenues derived therefrom.

Taking $77.66, then as the total sales and revenue per weighted ton at average 1938 price levels, the practical effect of the comparative inelasticity of demand for steel may be examined.

TABLE 31.—*Transportation and Miscellaneous Revenues Per Weighted Ton of Products Shipped—United States Steel Corporation and Subsidiaries*

Year	Millions of Weighted Tons of Products Shipped	Transportation and Miscellaneous Revenues (Millions of Dollars)	Per Weighted Ton	Deviation from 1938
1927	13.0	85.2	$6.55	+$0.75
1928	14.0	88.7	6.34	+0.54
1929	15.1	95.5	6.32	+0.52
1930	11.9	53.6	4.50	−1.30
1931	8.1	35.0	4.32	−1.48
1932	4.4	21.8	4.95	−0.85
1933	6.2	25.7	4.15	−1.65
1934	6.1	30.0	4.92	−0.88
1935	7.6	39.1	5.14	−0.66
1936	11.0	53.2	4.84	−0.96
1937	13.2	57.2	4.33	−1.47
1938	7.8	45.3	5.80	−0.00

In 1937 approximately 13,200,000 weighted tons of products were shipped by the Corporation's subsidiaries. In 1938 this tonnage dropped to 7,800,000, a decrease of 5,400,000. To bring the 1938 volume up to the 1937 level a 69.23% increase would have been needed. Since steel has at best an elasticity of 1, it would have been necessary to drop the price at least to a point where 13,200,000 tons would have brought in the same amount of dollars as the 7,800,000 tons did at 1938 prices. Since the total sales, as distinguished from other revenues, amounted to $560,508,000 in 1938, the $71.86 sales per weighted ton would have to have been reduced to $560,508,000 divided by 13,200,000, or $42.46 per weighted ton. This represents a price decrease of 40.9%. Disregarding the possibility that other operations might not expand with increased shipments and adding in the full $5.80 per weighted ton realized from other operations under actual 1938 conditions, the total sales and operating revenues would then have amounted to $48.26 per weighted ton. Since the variable cash costs amount to $53.36 per weighted ton, the Corporation would have sustained a cash loss of $5.10 on every weighted ton sold in addition to failing to recover any part of the fixed cash costs of $152,600,000. Assuming that the price reduction would have been successful in restoring the 1937 volume, 13,200,000 weighted tons would have been sold. At a loss of $5.10 a ton, the variable cash costs that would not have been covered by the sales price would amount to $67,320,000. Adding in the $152,600,000 fixed costs not covered by the sales price, the Corporation would have had a cash loss for the year of $219,920,000. This is without making any provision for the depreciation and depletion of the fixed assets of the Corporation and its subsidiaries. The average working capital of the Corporation for the year 1938 amounted to $397,241,615.[6] Hence, the drain of such a cash loss upon the Corporation would have exhausted its working capital in less than two years. If the amount of the depreciation and depletion of assets at this volume of operations, amounting to $60,784,000, is added to the cash loss, there is a total loss of $280,704,000. Annual losses at this rate would wipe out the combined equity of the preferred and common stockholders as of December 31, 1938, in about four and a half years.

[6] For computation of average working capital, see Appendix I.

Probably such drastic decreases, however, are not contemplated by those who criticize the steel industry for failing to reduce prices. While a smaller decrease in price could not have been expected under any circumstances to raise the 1938 volume to the 1937 level, it may nevertheless be contended that some price reduction and some resulting stimulation in volume were desirable. The facts are that any further price reduction in 1938 would have served but to increase the loss sustained. Chart 15 shows the actual deficit in 1938, amounting to $8,758,572 after the deduction of bond interest but before the Federal income and profits taxes and exclusive of non-operating income and expense. Added thereto are the amounts of additional deficit that would have been incurred if various percentage reductions in price had been made, assuming that steel has an elasticity of demand of 1. For instance, even a 1% reduction in price would have increased the 1938 loss by well over $3,000,000, while a 10% reduction in price would have resulted in an additional loss, after allowing for the maximum probable increase in volume, of over $43,000,000. To the extent that the assumed increases in volume might have failed to result from the decreases in price, of course, the additional losses would have been greater. The figures on which the chart is based,[7] together with the additions to the 1938 deficit which would have taken place if prices had been reduced and no increase in volume resulted, are shown in Table 32.

TABLE 32.—*Estimated Additions to 1938 Deficit—How Deficit Would Have Increased if Average 1938 Prices Had Been Reduced Various Percentages—United States Steel Corporation and Subsidiaries*

Percentage Reduction in Price	Estimated Additional Loss, Assuming Elasticity of Demand for Steel of 1	Estimated Additional Loss, if No Increase in Volume Resulted from Price Reduction	Percentage Reduction in Price	Estimated Additional Loss, Assuming Elasticity of Demand for Steel of 1	Estimated Additional Loss, if No Increase in Volume Resulted from Price Reduction
1	$3,900,000	$5,600,000	11	$48,100,000	$61,700,000
2	7,900,000	11,200,000	12	53,100,000	67,300,000
3	12,000,000	16,800,000	13	58,200,000	72,900,000
4	16,200,000	22,400,000	14	63,400,000	78,500,000
5	20,500,000	28,000,000	15	68,700,000	84,100,000
6	24,900,000	33,600,000	16	74,200,000	89,700,000
7	29,300,000	39,200,000	17	79,800,000	95,300,000
8	33,900,000	44,800,000	18	85,500,000	100,900,000
9	38,500,000	50,400,000	19	91,400,000	106,500,000
10	43,300,000	56,100,000	20	97,400,000	112,100,000

The relationship between steel prices, volume and costs for the United States Steel Corporation and its subsidiaries is such that the probable increase in volume which would result from a price decrease is never as great as the increase which would be required to compensate for the reduced amount received per ton. For instance, the relationship between the average 1938 prices and costs is illustrated in Chart 16. This chart reveals that the total sales and revenues at 1938 prices would cover all of the costs only if production amounted to 8.31 millions of weighted tons of product or more. The dashed sales line shows the total sales and revenue that would be realized if the prices at which the products were sold were reduced 10% without making any reduction in the rates charged in the transportation and miscellaneous operations. It should be noted that with this reduction in price, production would have to reach 12.36 millions of weighted tons to break even.[8] This represents an increase in volume of 48.8% required to compensate for the decreased prices. The same relationship holds not only with regard to the break-even point, but also to the netting of any particular amount of profit or loss. For instance, if production amounted to 6,000,000 weighted tons, the loss at 1938 average prices would be about $50,500,000. If 1938 prices were decreased 10%, volume would have to be raised 48.8%, or to about 8,925,000 weighted tons, in order not to increase the loss.

In Table 33 are shown and on Chart 17 are graphed the percentage increases in volume that would be required to compensate for various percentage decreases from the 1938 average prices as compared with the maximum probable increase in volume that would result from a price decrease.[9] This probable increase is based on the assumption that the elasticity of the demand for steel is 1. As has been mentioned above, all the evidence indicates that this is a most optimistic estimate and that the real figure is considerably smaller.

[7] For method of computation, see Appendix III.
[8] See Appendix IV for computation of break-even points.
[9] See Appendix V for method of computation.

CHART 15

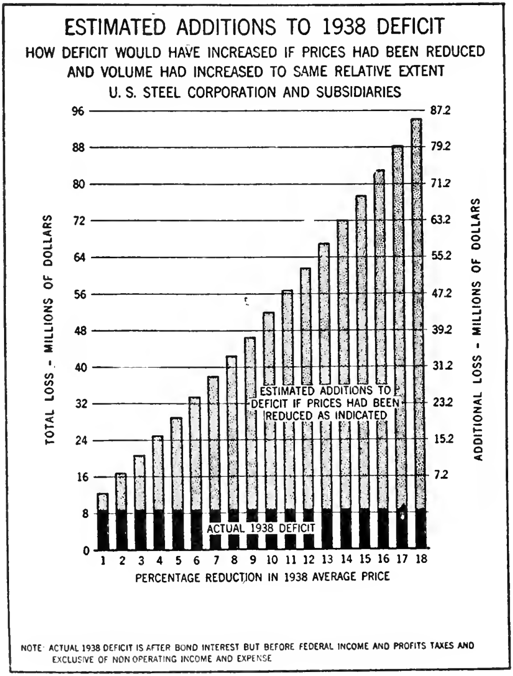

ESTIMATED ADDITIONS TO 1938 DEFICIT
HOW DEFICIT WOULD HAVE INCREASED IF PRICES HAD BEEN REDUCED AND VOLUME HAD INCREASED TO SAME RELATIVE EXTENT
U. S. STEEL CORPORATION AND SUBSIDIARIES
TOTAL LOSS - MILLIONS OF DOLLARS
ADDITIONAL LOSS - MILLIONS OF DOLLARS
96
88
80
72
64
56
48
40
32
24
16
8
0
87.2
79.2
71.2
63.2
55.2
47.2
39.2
31.2
23.2
15.2
7.2
ESTIMATED ADDITIONS TO DEFICIT IF PRICES HAD BEEN REDUCED AS INDICATED
ACTUAL 1938 DEFICIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
PERCENTAGE REDUCTION IN 1938 AVERAGE PRICE
NOTE: ACTUAL 1938 DEFICIT IS AFTER BOND INTEREST BUT BEFORE FEDERAL INCOME AND PROFITS TAXES AND EXCLUSIVE OF NON OPERATING INCOME AND EXPENSE

CHART 16

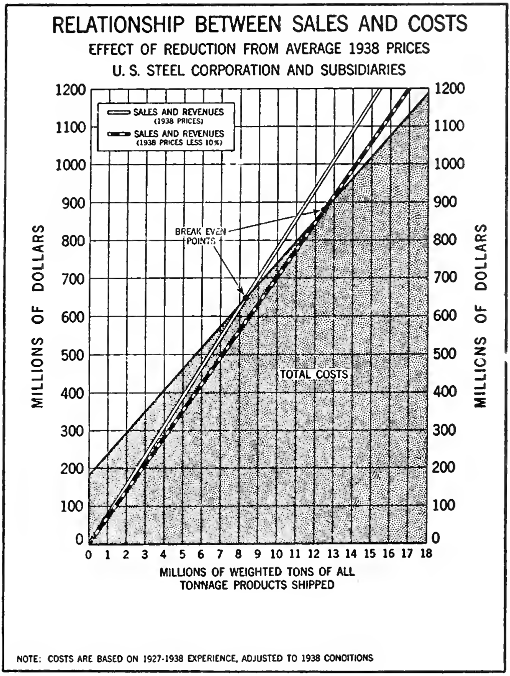

RELATIONSHIP BETWEEN SALES AND COSTS
EFFECT OF REDUCTION FROM AVERAGE 1938 PRICES
U. S. STEEL CORPORATION AND SUBSIDIARIES
SALES AND REVENUES (1938 PRICES)
SALES AND REVENUES (1938 PRICES LESS 10%)
BREAK EVEN POINTS
TOTAL COSTS
MILLIONS OF DOLLARS
MILLIONS OF DOLLARS
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
MILLIONS OF WEIGHTED TONS OF ALL TONNAGE PRODUCTS SHIPPED
NOTE: COSTS ARE BASED ON 1927-1938 EXPERIENCE, ADJUSTED TO 1938 CONDITIONS

CHART 17

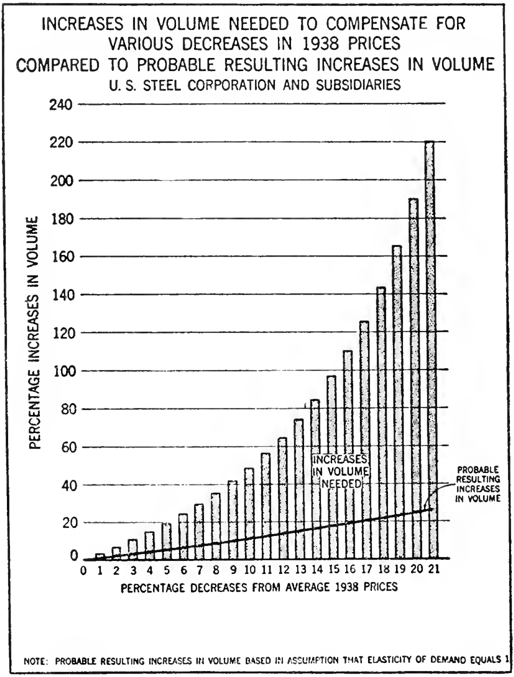


TABLE 33.—*Increases in Volume Needed to Compensate for Various Decreases in Average 1938 Prices—Compared to Probable Resulting Increases in Volume—United States Steel Corporation and Subsidiaries*

Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1	Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1
1	3.4	1.0	10	48.8	11.1
2	7.0	2.0	11	56.4	12.4
3	10.9	3.1	12	64.8	13.6
4	15.1	4.2	13	74.2	14.0
5	19.6	5.3	14	84.8	16.3
6	24.5	6.4	15	96.7	17.7
7	29.8	7.5	20	190.3	25.0
8	35.5	8.7	25	453.6	33.3
9	41.8	9.9	30	5858.2	42.9

Since the average 1938 prices represent the average results of prices in effect before and after the June 24, 1938 price reduction, a similar analysis to that made above has been made with the total sales and revenue line reduced to what it would have been if the prices prevailing in the second half of 1938, after the price reduction, had prevailed the entire year.

The total sales and revenue line at the prices prevailing in the second half of 1938 was computed by adjusting the sales component of the total sales and revenue per weighted ton computed above, on the basis of the selling value of rolled and finished steel products sold during the second half of 1938, as compared to the average selling value of these products for the entire year. The f. o. b. selling value of rolled and finished steel products sold each month was obtained from the Comptroller's Department of the Corporation. The total selling value of rolled and finished steel products for the last six months of the year, divided by the weighted tonnage of such products shipped during that period, gives the average amount per weighted ton received after the June 24, 1938 price reduction. The selling value for the entire year, divided by the weighted tonnage shipped during the entire year, furnishes the average amount received per weighted ton of rolled and finished steel products for the year as a whole. The $71.86 referred to above as the sales per weighted ton of tonnage products shipped represents the amount received for all products sold per weighted ton of all tonnage products shipped. Multiplying this figure by the ratio of the average steel price computed above for the last half of 1938 to the average price for 1938 as a whole, gives an estimate of the total sales per weighted ton of products if the same proportionate reductions in the prices of rolled and finished steel products that were in effect in the second half of 1938 had been applied to all products sold and had been put into effect at the beginning of the year. The computation, made in Table 34, shows that the sales per weighted ton would then be $67.33. Adding to this the $5.80 per weighted ton arising from miscellaneous transportation operations, the estimated total annual sales and revenues per weighted ton at prices prevailing after the June 24, 1938 price reduction would be $73.13.

TABLE 34.—*Estimate of Annual Sales and Revenue at Prices Prevailing in Second Half of 1938—United States Steel Corporation and Subsidiaries*

Period	F. O. B. Selling Value of Rolled and Finished Steel Products Shipped [1]	Weighted Tons of Rolled and Finished Steel Products Shipped [1]	Selling Value Per Weighted Ton
Jan. to June, 1938	$230,750,804	3,087,392	$74.74
July to Dec., 1938	246,835,450	3,798,057	64.99
Year 1938	$477,586,254	6,885,449	$69.36

Item	1938 Average Per Weighted Ton	Adjustment	Second Half 1938 Average Per Weighted Ton
Sales	$71.86	64.99/69.36	$67.33
Transportation and Miscellaneous Revenues	5.80		5.80
Total Sales and Revenues	$77.66		$73.13

[1] Before yearly adjustment for returns and allowances, amounting to $4,732,196 and 3,504 unweighted tons.

TABLE 35.—*Increases in Volume Needed to Compensate for Various Decreases in 2nd Half, 1938, Prices Compared to Probable Resulting Increases in Volume—United States Steel Corporation and Subsidiaries*

Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1	Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentae Increase Assuming Elasticity of 1
1	4.0	1.0	10	63.1	11.1
2	8.4	2.0	11	74.1	12.4
3	13.1	3.1	12	86.7	13.6
4	18.3	4.2	13	101.3	14.9
5	24.0	5.3	14	118.3	16.3
6	30.2	6.4	15	138.4	17.7
7	37.2	7.5	20	342.6	25.0
8	44.8	8.7	25	2984.4	33.3
9	53.5	9.9			

Chart 18 shows the price, cost, and volume relationship under prices prevailing in the second half of 1938. Here again the revenues at higher volumes have been overstated to the extent that the transportation and miscellaneous revenues might drop below $5.80 per weighted ton if shipments were increased. Nevertheless it may be noted that the break-even point at these prices is 10.47 millions of weighted tons, as compared with 8.31 millions of weighted tons at the average 1938 prices. Similarly, a 10% decrease in the second half of 1938 prices would be offset only if volume were increased 63.1% to 17.1 millions of weighted tons. This would mean that the Corporation would have to operate at an average of over 90% of capacity for the entire year in order to break even. Table 35 and Chart 19 show the percentage increase in volume required to compensate for various decreases in the second half of 1938 prices [10] as compared to the increase in volume that would result from the drop in prices if the elasticity of demand for steel were as high as 1.[11]

In connection with the break-even point, it has been contended that in a truly competitive arrangement the break-even point will be only a little bit short of capacity. It has already been shown that if the prices prevailing in the second half of 1938 were reduced by 10%, the break-even point for the Corporation and its subsidiaries would be moved up to over 90% capacity. The effect of this high break-even point on the possible return on investment that might be realized by the Corporation may be seen by calculating the rate of operation that would have to be maintained to realize an average return as modest as 5% on the entire tangible investment. The average investment of the Steel Corporation, consisting of the combined interests of stockholders and bondholders, after eliminating all intangible values, for the year 1938 amounted to $1,586,523,686. A 5% return on this investment would require a profit before bond interest of over $79,300,000. Deducting bond interest of $8,300,000, this leaves a profit after bond interest of over $71,000,000 to be obtained. Even if Federal income taxes are disregarded, to realize such a profit at prices 10% below second half of 1938 prices, which would be low enough to put the break-even point at around 90% of capacity, the Corporation would have to operate throughout the year at an average rate of over 130% of capacity, an obvious impossibility.[12]

VI. Weighted Tonnages and the Operating Rate

The operating rate for the subsidiaries of the United States Steel Corporation, as ordinarily computed and as published in the annual reports, is obtained by dividing the total number of tons of rolled and finished steel products produced by the estimated capacity in tons for producing rolled and finished steel products. This figure has its limitations as an indicator of steel producing activities. For instance, the production of a million tons of sheets, with all the processing that they require, would involve considerably more activity than the production of the same quantity of rails, which are more simple to produce, yet either would result in the same operating rate.

[10] See Appendix V for method of computation.

[11] While the assumption of any elasticity of demand for steel greater than 1 is highly unrealistic, it is interesting to note that even if steel had an elasticity of 1.5 or 2, the percentage increase in volume needed to offset a price reduction would still greatly exceed the percentage increase in volume which would then result from reducing prices:

Decrease in Price	Resulting Increase in Volume		Increase in Volume Needed to Offset:	
	If Elasticity=1.5	If Elasticity=2	Decrease in Average 1938 Steel Prices	Decrease in Second Half 1938 Steel Prices
1%	1.5%	2.0%	3.4%	4.0%
2%	3.1%	4.1%	7.0%	8.4%
3%	4.7%	6.3%	10.9%	13.1%
4%	6.3%	8.5%	15.1%	18.3%
5%	8.0%	11.1%	19.6%	24.0%
10%	17.1%	23.5%	48.8%	63.1%
15%	27.6%	38.4%	96.7%	138.4%
20%	39.8%	56.3%	190.3%	342.6%
25%	54.0%	77.8%	453.6%	2984.4%
30%	70.8%	104.1%	5858.2%	(No increase sufficient)

[12] See Appendix VI for computations involved.

CHART 18

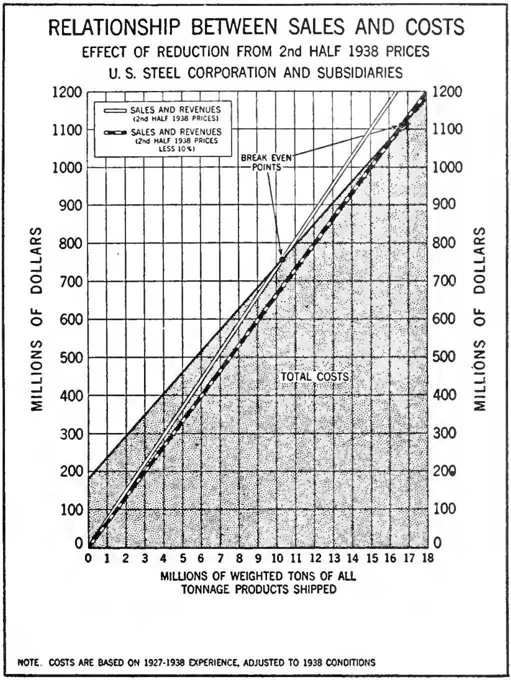
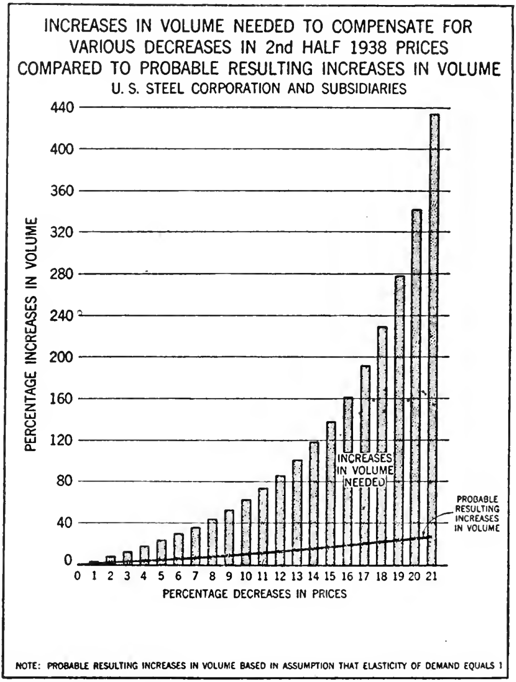


TABLE 36.—*Weighted Tonnages of All Tonnage Products and Unweighted Tonnages of Rolled and Finished Products Shipped—United States Steel Corporation and Subsidiaries*

Year	Weighted Tons All Tonnage Products Shipped	Actual Tons Rolled and Finished Products Shipped	Year	Weighted Tons All Tonnage Products Shipped	Actual Tons Rolled and Finished Products Shipped
1927	13, 008, 520	12, 993, 283	1933	6, 160, 338	5, 811, 328
1928	13, 994, 239	13, 973, 129	1934	6, 096, 937	5, 911, 760
1929	15, 088, 968	15, 234, 355	1935	7, 631, 783	7, 356, 185
1930	11, 934, 595	11, 624, 294	1936	11, 012, 458	10, 784, 716
1931	8, 130, 577	7, 676, 744	1937	13, 186, 548	12, 789, 841
1932	4, 352, 016	3, 974, 062	1938	7, 758, 891	6, 659, 253

In making this study of the relation of cost to volume it was apparent that the cost of producing a million tons of rails, for instance, would be lower than the cost of producing a million tons of sheets. For this reason, as has already been mentioned, the tonnages of each type of product shipped were weighted on the basis of the average mill cost for that type of product. Both the subdivisions of rolled and finished steel products and the main classifications of tonnage products other than steel were weighted by the ratio of their average mill cost to the average

CHART 19



mill cost of all rolled and finished products. In this way the actual tonnages shipped each year were converted to equivalent tons of average cost rolled and finished steel products. Accordingly, the break-even point at various price levels has been stated in terms of weighted tonnages and it is essential to keep in mind the relationship between these weighted tonnage figures and the regular operating rate figures if the significance of the weighted tonnage figures is to be properly appreciated.

Table 36 shows the unweighted tonnages of rolled and finished steel products shipped each year, together with the corresponding weighted tonnages of all tonnage products. The weighted and unweighted tonnages are plotted in relation to each other on Chart 20. Inspection of the chart shows that the points for each year fall very nearly in a straight line but that as the unweighted tonnages decrease, the weighted tonnages do not decrease quite so rapidly, indicating that in slack years the sales of heavy, low-cost steel products fall off relatively more than the sales of the lighter, high-cost items and of the products other than steel. Computation of the line of average relationship by the least squares method shows that the weighted tonnage is generally 95.36% of the unweighted tonnage plus 742,000 tons. This would indicate that if the shipments of rolled and finished steel products reached the January 1st, 1939 capacity of approximately 17,940,000 tons, the corresponding weighted tonnage shipped would amount to about 17,850,000 weighted tons. On the basis of the average relationship existing between weighted and unweighted tonnages at various shipment levels, it is possible to compute the weighted tonnages and the percent of capacity operated based on weighted tonnages, which would be equivalent to various operating rates as ordinarily computed. The results of this computation are tabulated in Table 37

CHART 20

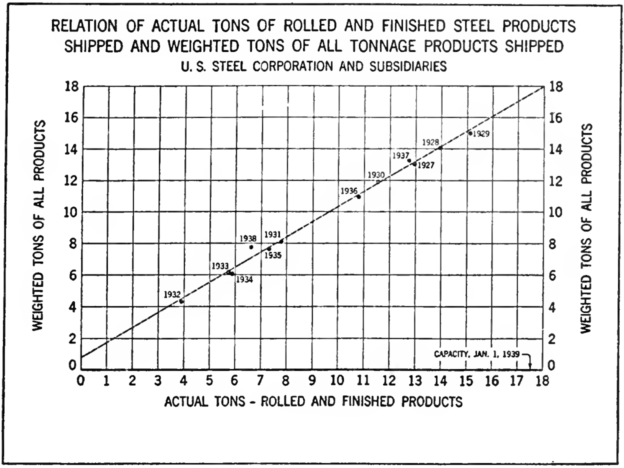


TABLE 37.—*Average Weighted Equivalent of Unweighted Tonnages—United States Steel Corporation and Subsidiaries*

Actual Tons Rolled and Finished Products (Millions of Tons)	Percent of 1/1/39 Capacity	Average Equivalent Weighted Tonnage of All Products (Millions of Tons)	Percent of Estimated 1/1/39 Weighted Capacity
.90	5	1.60	9.0
1.79	10	2.45	13.7
2.69	15	3.31	18.5
3.59	20	4.17	23.4
4.49	25	5.02	28.1
5.38	30	5.87	32.9
6.28	35	6.73	37.7
7.18	40	7.59	42.5
8.07	45	8.44	47.3
8.97	50	9.30	52.1
9.87	55	10.15	56.9
10.76	60	11.00	61.6
11.66	65	11.86	66.4
12.56	70	12.72	71.3
13.46	75	13.58	76.1
14.35	80	14.43	80.9
15.25	85	15.28	85.6
16.15	90	16.14	90.4
17.04	95	16.99	95.2
17.94	100	17.85	100.0

It should be noted, however, that all of the points on Chart 20 do not fall exactly on the average line. These variations from year to year constitute one reason for using weighted rather than unweighted tonnages in making this study. To the extent that the relationship between weighted and unweighted tonnages in any year is different from the average relationship for the volume involved, the equivalent weighted tonnage figures given in Table 37 will be inaccurate. Since this variance in relationship between weighted and unweighted tonnages arises from differing proportions of each type of product constituting the total sales, the amount of the variance becomes more limited as operations approach

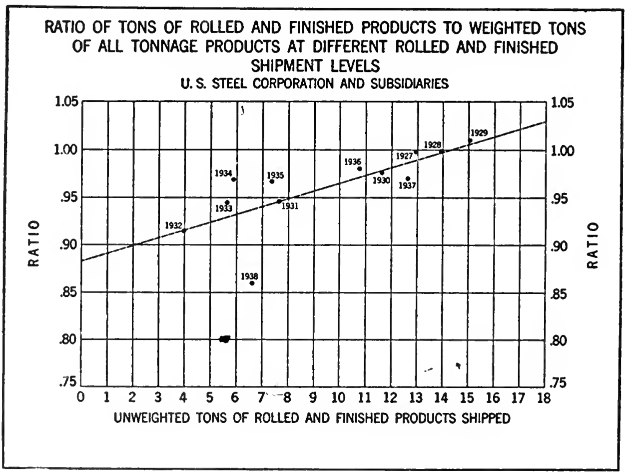
capacity, since at capacity the proportions are fixed by the capacity for producing each type of product.

TABLE 38.—*Ratio of Tons of Rolled and Finished Products to Weighted Tons of All Tonnage Products—United States Steel Corporation and Subsidiaries*

Year	Unweighted Tons Rolled and Finished Products Shipped	Weighted Tons All Tonnage Products	Ratio Unweighted to Weighted
1927	12.99	13.01	0.9985
1928	13.97	13.99	0.9986
1929	15.23	15.09	1.0093
1930	11.62	11.93	0.9740
1931	7.68	8.13	0.9446
1932	3.97	4.35	0.9126
1933	5.81	6.16	0.9432
1934	5.91	6.10	0.9689
1935	7.36	7.63	0.9646
1936	10.78	11.01	0.9791
1937	12.79	13.19	0.9697
1938	6.66	7.76	0.8582

Since the variations from average do not show up very clearly in Chart 20, the percentage of weighted tons of all tonnage products shipped represented by unweighted tons of rolled and finished products is computed in Table 38. The resulting data are graphed on Chart 21. Here again it becomes apparent that the actual tonnages tend to be smaller than the weighted tonnages when operating rates are low. Deviations of the individual points from the line of average relationship, however, are considerable. In 1938, for instance, the ratio of the unweighted tonnages shipped to the weighted tonnages was even smaller than would be expected on the basis of the average relationship on which Table 37 is based. Thus the 1938 shipments of rolled and finished steel products, amounting to 6.66 millions of unweighted tons or 37.1% of January 1st, 1939, capacity, would normally be expected to equal 7.09 millions of weighted tons of all tonnage products, or 39.7% of weighted capacity. As a matter of fact, however, the

CHART 21



weighted tonnage in 1938 amounted to 7.76 millions of weighted tons, or 43.4% of weighted capacity. This indicates that no percentage of capacity as ordinarily computed can be named as the break-even point, since the exact percentage at which the Corporation would break even will depend upon the type of products composing the total products sold, and these vary considerably from year to year, even when total shipments are approximately the same.

Some of the year to year variations in the relation between the weighted tonnages of all tonnage products and the unweighted tonnages of rolled and finished products shipped are accounted for by variations in the percentage of light and heavy steel products shipped, and others by the amount of products other than steel which are sold. In order that the causes of the variations may be observed, the percentage relationships between the unweighted tonnages of each class of products shipped and the total tonnage of rolled and finished steel products shipped are given in Table 39. Notice should be taken of the fact, however, that the apparent increase in the tonnage of sundry materials and by-products sold in 1938 is partly the result of including in sales, cost of goods sold, and sundry materials and by-products, shipped, the sales of crushed slag. In prior years the net proceeds from the sale of this item were included in miscellaneous income. The total tonnage of sundry materials and by-products in 1938 would amount to 6.3% of the tonnage of rolled and finished steel products shipped, if computed on the same basis as in prior years.

TABLE 39.—*Percentage of Tons of Various Classes of Products Shipped to Total Tons of Rolled and Finished Products Shipped—1927–1938—United States Steel Corporation and Subsidiaries*

Class of Product	Percentage of Total Tons of Rolled and Finished Products Shipped											
	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
1 Semi-Finished	7.2	8.0	8.1	8.4	9.0	11.8	13.8	12.5	14.5	14.1	13.5	10.9
2 Rails	11.4	9.8	9.0	6.1	7.8	4.6	3.9	8.6	5.4	6.2	6.0	5.1
3 Plates	11.0	10.6	12.5	11.9	8.1	4.5	5.5	6.2	5.3	7.3	9.1	6.8
4 Heavy Structural Shapes	7.0	7.6	8.7	8.6	7.3	6.7	4.9	6.4	5.8	7.6	7.7	7.7
5 Merchant Bar, H. R. Strip, Hoops, etc	18.3	20.6	20.7	18.4	18.2	17.4	20.2	18.5	21.2	21.0	19.7	17.3
6 Sheets, Black and Tin Plate	12.7	14.1	13.6	13.6	14.7	17.6	21.3	19.5	20.9	18.0	19.2	22.0
7 Cold Rolled Strip, Wire and Wire Products	10.6	10.1	9.3	9.5	11.6	14.3	15.3	12.1	13.0	10.8	8.6	11.8
7a Copper Products and Insulated Wires and Cables	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.3
8 Tubular Products	12.3	10.5	10.0	11.3	9.7	7.5	5.8	7.9	6.7	7.8	8.6	9.0
9 Fabricated Structural Shapes	4.4	4.0	3.6	5.5	9.2	11.6	5.6	3.5	3.1	2.8	3.2	5.4
10 Angle Bars, Tie Plates and All Other Rail Joints	2.1	1.8	1.5	1.6	1.6	1.3	1.1	1.4	1.0	1.3	1.2	1.1
Total 1 to 10	97.3	97.4	97.2	97.2	97.5	97.6	97.6	96.8	97.1	97.1	97.0	97.4
11 Axles	0.3	0.2	0.5	0.4	0.1	0.1	0.1	0.2	0.2	0.3	0.5	0.2
12 Wheels	0.6	0.4	0.6	0.6	0.5	0.6	0.5	0.6	0.4	0.5	0.6	0.4
13 Nuts, Rivets, Spikes, Bolts	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2
14 Foundry Products	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.3
15 Special Track Work	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
16 Sundry Iron and Steel Products	0.7	0.9	0.7	0.8	1.1	1.0	1.1	1.6	1.5	1.3	1.2	1.4
Total 11 to 16	2.7	2.6	2.8	2.8	2.5	2.4	2.4	3.2	2.9	2.9	3.0	2.6
A. All Rolled and Finished Steel	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
B. Pig Iron, Ingots, Ferro and Scrap	1.8	2.5	2.4	2.8	3.0	2.1	3.0	2.8	3.8	7.1	8.0	9.6
C. Limestone, Coal, Coke and Iron Ore	4.4	30.6	40.8	38.4	27.0	28.7	31.5	38.4	38.0	28.3	29.1	43.7
D. Sundry Materials and By-Products	2.1	2.3	2.3	3.6	3.5	3.2	3.1	3.7	3.4	3.9	4.1	[1] 15.2
Total Tons of All Products Sold on Tonnage Basis	108.3	135.4	145.5	144.8	133.5	134.0	137.6	144.9	145.2	139.3	141.2	168.5

[1] If on same basis as other years, would be 6.3.

In order that the effect of variations in the proportionate amounts of each type of rolled and finished products, as distinguished from variations in the proportionate amount of products other than rolled and finished steel products, may be further shown, Table 40 gives the unweighted tonnages of rolled and finished products shipped each year, together with the weighted tonnages of rolled and finished products only, exclusive of other tonnage products. The graphing of these data on Chart 22 shows clearly that the more costly light products constitute a higher proportion of sales in slack periods, since the percentage of weighted tons of rolled and finished products represented by unweighted tons falls off considerably as the operating rate goes down. It is again noticeable that there is also considerable variance in the relationship between weighted and unweighted tonnages of rolled and finished products shipped in years in which the unweighted tonnages were approximately similar. For example, the chart shows that in the year 1934 the actual tonnage was much nearer to the amount of the weighted tonnage than would be expected at such a low shipment level. The explanation may be obtained by an inspection of Table 39, which shows that in 1934 rails, plates and other heavy, lower cost products constituted almost as great a percentage of the total shipments as in years when the operating rate was much higher.

TABLE 40.—*Ratio of Unweighted to Weighted Tons of Rolled and Finished Products—United States Steel Corporation and Subsidiaries*

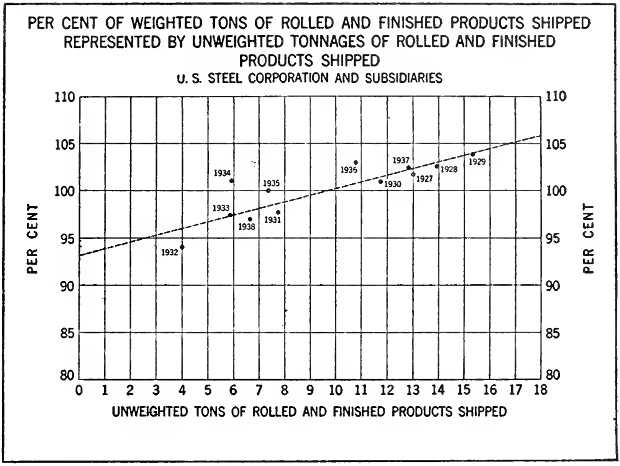
Year	Actual Tons Rolled and Finished Products	Weighted Tons Rolled and Finished Products	Ratio Unweighted to Weighted
1927	12.99	12.75	1.0187
1928	13.97	13.62	1.0258
1929	15.23	14.66	1.0395
1930	11.62	11.51	1.0103
1931	7.68	7.86	0.9766
1932	5.97	4.23	0.9397
1933	5.81	5.97	0.9732
1934	5.91	5.89	1.0039
1935	7.36	7.36	0.9996
1936	10.79	10.47	1.0297
1937	12.79	12.49	1.0243
1938	6.66	6.89	0.9672

All in all, then, it may be said that the weighted tonnage figures arrived at in this study are a fairly accurate indication of the true break-even point. There is not a sufficiently constant relationship between weighted and unweighted tonnages, however, to make possible an accurate conversion of the break-even point, expressed in weighted tonnages, to a break-even point expressed in terms of percentage of capacity operated, as this percentage is ordinarily computed. The conversion made in Table 37 can serve as a rough guide and nothing more. It indicates that the break-even point, under prices prevailing in the last half of 1938, of approximately ten and a half million weighted tons would represent about 55% of capacity on the ordinary basis. If the preponderance of light products that prevailed during 1938 recurred, the equivalent unweighted tonnage would be somewhat lower, reducing the break-even point to about 50%. Regardless of this variation, the entire study indicates beyond question that the nature of the demand for steel and the cost pattern of the United States Steel Corporation and its subsidaries are such that the increased volume of sales that might result could not compensate for a general price reduction, and that general lowering of prices is not the road to prosperity, undiminished employment. and undiminished payrolls in the steel industry.

APPENDIX I. COMPUTATION OF AVERAGE WORKING CAPITAL—1938

Item	Jan. 1, 1938	Dec. 31, 1938	Total
Current Assets	$480,737,119.87	$510,338,510.30	$991,075,630.17
Current Liabilities	117,331,070.84	79,261,328.94	196,592,399.78
Working Capital	$363,406,049.03	$431,077,181.36	$794,483,230.39
Average Working Capital			$397,241,615.19

CHART 22



APPENDIX II. COMPUTATION OF PERCENTAGE INCREASE IN VOLUME TO BE EXPECTED FROM PERCENTAGE DECREASE IN PRICE, ASSUMING ELASTICITY OF DEMAND FOR STEEL OF 1

Let:

p = price
v = volume
s = total sales in dollars
d = fractional decrease in price
i = fractional increase in volume

Then:

(1) $pv=s$

If the elasticity of demand for steel is 1, a decrease in price will be accompanied by a corresponding increase in volume sufficient to keep the total sales in dollars unchanged.

Hence:

(2) $(p-pd)\ (v+vi)=s$

Substituting from (1):

(3) $(p-pd)\ (v+vi)=pv$

Factoring:

(4) $pv\ (1-d)\ (1+i)=pv$

Dividing by pv (1-d):

(5) $1+i=\dfrac{pv}{pv\ (1-d)}$

Simplifying:

(6) $1+i=\dfrac{1}{1-d}$

Subtracting 1 from each side of the equation:

(7) $i=\dfrac{1}{1-d}-1$

Simplifying:

(8) $$i=\frac{1}{1-d}-\frac{1-d}{1-d}=\frac{1-1+d}{1-d}=\frac{d}{1-d}$$

$$i=\frac{d}{1-d}$$

Substituting various values for d:

d	i	d	i	d	i	d	i	d	i
0.01	0.0101	0.11	0.1236	0.21	0.2658	0.31	0.4493	0.41	0.6949
.02	.0204	.12	.1364	.22	.2821	.32	.4706	.42	.7241
.03	.0309	.13	.1494	.23	.2987	.33	.4925	.43	.7544
.04	.0417	.14	.1628	.24	.3158	.34	.5152	.44	.7857
.05	.0526	.15	.1765	.25	.3333	.35	.5385	.45	.8182
.06	.0638	.16	.1905	.26	.3514	.36	.5625	.46	.8519
.07	.0753	.17	.2048	.27	.3699	.37	.5873	.47	.8868
.08	.0870	.18	.2195	.28	.3889	.38	.6129	.48	.9231
.09	.0989	.19	.2346	.29	.4085	.39	.6393	.49	.9608
.10	.1111	.20	.2500	.30	.4286	.40	.6667	.50	1.0000

Appendix III. Actual Operating Deficit in 1938 and Estimated Addition to Deficit if Prices Had Been Further Reduced

Actual Operating Deficit—1938:

Actual Deficit Before Provision for Income Taxes but after Interest, as per Statement to F. T. C.		\$4, 787, 454
Non-Operating Income:		
"Other Income (Net)", as per Statement to F. T. C.	\$2, 524, 320	
Add: Idle Plant Expenses included therein	2, 440, 185	
	4, 964, 505	
Subtract: Discounts on Purchases included therein	993, 387	
		3, 971, 118
Actual Operating Deficit		8, 758, 572

Estimated Addition to Deficit if Prices Had Been Further Reduced:

Given:

1938 volume = 7.8 millions of weighted tons.

Sales at 1938 prices = \$71.86 per weighted ton.

1938 transportation and miscellaneous revenues = \$5.80 per weighted ton.

Costs = \$55.734 per weighted ton + 182.1 millions of dollars.

Let:

d = fractional reduction in price.

i = resulting increase in volume.

X = the additional loss (in millions of dollars).

L = average loss at 1938 average prices and volume (in millions of dollars).

L_1 = average loss at reduced price and changed volume (in millions of dollars).

Then:

(1) $X=L_1-L$

Since losses equal costs minus sales and revenues:

(2) $L=[55.734\ (7.8)+182.1]-[71.86\ (7.8)+5.80\ (7.8)]$.

(3) $L_1=[55.734\ (7.8)\ (1+i)+182.1]-[71.86\ (1-d)\ (7.8)\ (1+i)+5.80\ (7.8)\ (1+i)]$

Removing brackets and simplifying (2):

(4) $L=55.734\ (7.8)+182.1-71.86\ (7.8)-5.80\ (7.8)$

(5) $L=182.1-21.926\ (7.8)$

(6) $L=11.077$

Removing brackets and simplifying (3):

(7) $L_1=55.734\ (7.8)\ (1+i)+182.1-71.86\ (1-d)\ (7.8)\ (1+i)-5.80\ (7.8)\ (1+i)$

(8) $L_1=49.934\ (7.8)\ (1+i)+182.1-(71.86-71.86d)\ (7.8)\ (1+i)$

Factoring:

(9) $L_1=7.8\ (1+i)\ [49.934-(71.86-71.86d)]+182.1$

Simplifying:

(10) $L_1=7.8\ (1+i)\ (49.934)-71.86+71.86d)+182.1$

$L_1=7.8\ (1+i)\ (71.86d-21.926)+182.1$

Substituting (6) and (10) in (1):

(11) $X=7.8\,(1+i)\,(71.86d-21.926)+182.1-11.077$

Simplifying:

(12) $X=(1+i)\ (560.508d-171.023)+171.023$

(13) $X=560.508d-171.023+560.508di-171.023i+171.023$

(14) $X=560.508d+560.508di-171.023i$

(15) $X=560.508d+i\ (560.508d-171.023)$

Additional Loss if Elasticity of Demand for Steel is as High as 1:

If the elasticity=1:

(16) $i=\frac{d}{1-d}$ (See Appendix II)

Substituting (16) and (15):

(17) $X=560.508d+\frac{d}{1-d}(560.508d-171.023)$

Simplifying:

(18) $X=\frac{560.508d-560.508d^2+560.508d^2-171.023d}{1-d}$

(19) $X=\frac{560.508d-171.023d}{1-d}$

(20) $X=\frac{389.485d}{1-d}$

Substituting various values for d:

d	X	d	X	d	X	d	X
0.1	3.9	0.06	24.9	0.11	48.1	0.16	74.2
.02	7.9	.07	29.3	.12	53.1	.17	79.8
.03	12.0	.08	33.9	.13	58.2	.18	85.5
.04	16.2	.09	38.5	.14	63.4	.19	91.4
.05	20.5	.10	43.3	.15	68.7	.20	97.4

Additional Loss if Prices Had Been Reduced and No Increase in Volume Resulted:

If no increase in volume resulted:

(21) $i=0$

Substituting (21) in (15) the general equation:

(22) $X=560.508d$

Substituting various values for d:

d	X	d	X	d	X	d	X
0.01	5.6	0.16	33.6	0.06	61.7	0.16	89.7
.02	1112	.07	39.2	.12	67.3	.17	95.3
.03	16.8	.08	44.8	.13	72.9	.18	100.9
.04	22.4	.09	50.4	.14	78.5	.19	106.5
.05	28.0	.10	56.1	.15	84.1	.20	112.1

Appendix IV. Weighted Tonnage Which Must Be Shipped to Break Even at Various Price Levels

Given:

Costs $=55.734\ V+182.1$, where:

Costs are in millions of dollars, and

V = millions of weighted tons shipped

Transportation and Miscellaneous Revenues under 1938 conditions = 5.80 V

Let: P = Sales per weighted ton shipped

$V_1=V$ at the break-even point

At the break-even point Sales and Revenues will equal costs; therefore:

$P\ V_1+5.80\ V_1=55.734\ V_1+182.1$

Transposing:

$$P\ V_1+5.80\ V_1-55.734\ V_1=182.1$$

Factoring and simplifying:

$$V_1\ (P-49.934)=182.1$$

Dividing by (P−49.934):

$$V_1=\frac{182.1}{P-49.934}$$

Substituting various values for P:

Price conditions	P	(P−49.934)	V_1
Average 1938	71.86	21.926	8.305
2d half 1938	67.33	17.396	10.468
Average 1938 less 10%	64.67	14.736	12.357
2d half 1938 less 10%	60.60	10.666	17.073

Appendix V. Computation of Increases in Volume Needed to Offset Decreases in Price

Given:

Total costs = 182.1 millions of dollars + \$55.734 per weighted ton.
Sales, average 1938 prices = \$71.86 per weighted ton shipped.
Sales, 2d half 1938 prices = \$67.33 " " " "
Transportation and miscellaneous revenues = \$5.80 " " " "

Let:

V = volume before price decrease, in weighted tons.
V_1 = volume, in weighted tons, needed to offset decrease in price.
S = sales, exclusive of other revenues, per weighted ton shipped before decrease in price.
d = fractional decrease in price.
x = fractional increase in volume needed to offset d.

Then:

(1) $$x=\frac{V_1-V}{V}=\frac{V_1}{V}-\frac{V}{V}=\frac{V_1}{V}-1$$

(2) Profit or loss before price decrease = SV + 5.80 V − (182.1 + 55.734 V)

(3) Profit or loss after price decrease = (S − dS) V_1 + 5.80 V_1 − 182.1 + 55.734 V_1

If the increase in V_1 over B is to offset the decrease in S, (2) and (3) will be equal. Hence:

(4) $$SV+5.80\ V-182.1-55.734\ V=(S-dS)\ V_1+5.80\ V_1-182.1-55.734\ V$$

Adding 182.1 to both sides:

(5) $$SV+5.80\ V-55.734\ V=(S-dS)\ V_1+5.80\ V_1-55.734\ V_1$$

Factoring and simplifying:

(6) $$V\ (S-49.934)=V_1\ [(S-dS)-49.934]$$

Removing brackets:

(7) $$V\ (S-49.934)=V_1\ (S-dS-49.934)$$

$$\frac{V_1}{V}=\frac{S-49.934}{S-dS-49.934}$$

Substituting in (1):

(8) $$x=\frac{S-49.934}{S-dS-49.934}-1$$

Substituting percentage decreases from the average 1938 prices.

At average 1938 prices:

$$x=\frac{71.86-49.934}{71.86-71.86d-49.934}-1=\frac{21.926}{21.926-71.86d}-1$$

Substituting various values for d:

d	21.926−71.86d	$\frac{21.926}{21.926-71.86d}$	$x\ (=\frac{21.926}{21.926-71.86d}-1)$
0.01	21.207	1.0339	.0339
.02	20.489	1.0701	.0701
.03	19.770	1.1091	.1091
.04	19.052	1.1509	.1509
.05	18.333	1.1960	.1960
.06	17.614	1.2448	.2448
.07	16.896	1.2977	.2977
.08	16.177	1.3554	.3554
.09	15.459	1.4183	.4183
.10	14.740	1.4875	.4875
.11	14.021	1.5638	.5638
.12	13.303	1.6482	.6482
.13	12.584	1.7424	.7424
.14	11.866	1.8478	.8478
.15	11.147	1.9670	.9670
.16	10.428	2.1026	1.1026
.17	9.710	2.2581	1,2581
.18	8.991	2.4387	1.4387
.19	8.273	2.6503	1.6503
.20	7.554	2.9026	1.9026
.21	6.835	3.2079	2.2079
.22	6.117	3.5844	2.5844
.23	5.398	4.0619	3.0619
.24	4.680	4.6850	3.6850
.25	3.961	5.5355	4.5355
.26	3.242	6.7631	5.7631
.27	2.524	8.6870	7.6870
.28	1.805	12.1474	11.1474
.29	1.087	20.1711	19.1711
.30	0.368	59.5815	59.5815

Substituting percentage decreases from 2d half, 1938, prices:

At 2d half, 1938, prices:

$$x=\frac{67.33-49.934}{67.33-67.33d-49.934}-1=\frac{17.396}{17.396-67.33d}-1$$

Substituting various values for d:

d	17.396−67.33d	$\frac{17.396}{17.396-67.33d}$	$x\ (=\frac{17.396}{17.396-67.33d}-1)$
0.01	16.723	1.040	.040
.02	16.049	1.084	.084
.03	15.376	1.131	.131
.04	14.703	1.183	.183
.05	14.030	1.240	.240
.06	13.356	1.302	.302
.07	12.683	1.372	.372
.08	12.010	1.448	.448
.09	11.336	1.535	.535
.10	10.663	1.631	.631
.11	9.990	1.741	.741
.12	9.316	1.867	.867
.13	8.643	2.013	1.013
.14	7.970	2.183	1.183
.15	7.297	2.384	1.384
.16	6.623	2.627	1.627
.17	5.950	2.924	1.924
.18	5.277	3.297	2.297
.19	4.603	3.779	2.779
.20	3.930	4.426	3.426
.21	3.257	5.341	4.341
.22	2.583	6.735	5.735
.23	1.910	9.108	8.108
.24	1.237	14.063	13.063
.25	0.564	30.844	29.844

APPENDIX VI. OPERATING RATE REQUIRED TO EARN 5% ON TANGIBLE INVESTMENT IF BREAK-EVEN POINT AT OVER 90% OF CAPACITY

	Jan. 1, 1938	*Dec. 31, 1938*
Tangible Investment:		
Assets	$1, 918, 729, 289	$1, 711, 279, 006
Less: Current Liabilities	117, 331, 071	79, 261, 329
Total Investment (Bondholders' & Stockholders' Interests)	$1, 801, 398, 218	$1, 632, 017, 677
Less Intangibles	260, 368, 522	1
Tangible Investment	$1, 541, 029, 696	$1, 632, 017, 676
Average Tangible Investment, 1938		$1, 586, 523, 686
5% Return on Average Tangible Investment		$79, 326, 184
Less: Bond Interest		8, 262, 327
Return after Bond Interest		$71, 063, 857

The break-even point would be at over 90% of capacity if prices were 10% lower than the average prices prevailing in the 2d half of 1938 (see Appendix IV). At these prices total sales and revenues would amount to $66.40 per weighted ton of tonnage products shipped.

At these prices, profits, before income taxes, in millions of dollars $=66.40-182.1-55.734$ V. (See Appendix IV.)

To realize 71.0 million dollars, ignoring income taxes:

$$71.0=66.40\text{ V}-182.1-55.734\text{ V}$$
$$10.666\text{ V}=253.1$$
$$\text{V}=\frac{253.1}{10.666}=23.73\text{ millions of weighted tons}$$

The trend of the relationship between tons of rolled and finished products shipped and weighted tons of all tonnage products shipped indicates that the weighted capacity figure for all tonnage products equivalent to the 17.9 millions of unweighted tons constituting the rolled and finished capacity as of January 1, 1939, would be 17.85 millions of weighted tons. Hence, at such prices operations would have to reach the impossible rate of $\frac{23.73}{17.85}$, or 133% of capacity, to realize a return as modest as 5% on tangible investment.

APPENDIX VII. EFFECT OF INTER COMPANY TRANSACTIONS ON PROFIT AND LOSS STATEMENT

The consolidated profit and loss statements of United States Steel Corporation, submitted to the Federal Trade Commission do not state the sales and revenues and the cost of goods sold and operating expenses of transportation and miscellaneous operations on a purely integrated basis. This is to say that the sales shown are not merely sales to purchasers other than subsidiaries of the Corporation, but include sales between subsidiary companies. Thus the sale for $80 of a product costing $60 to another subsidiary which resold it to outside purchasers for $100 would result in sales of $180 on the profit and loss statement. Cost of goods sold would similarly involve a duplication and would amount in all to $60, the cost to the first company, plus $80, the cost to the second company, or $140. This would leave a gross profit of $40. Considering the consolidated companies as a single unit, what has really happened is that goods costing $60 were sold for $100, leaving a profit of $40. Thus the profit is neither overstated nor understated by this method of handling. From an integrated viewpoint, both sales and costs are inflated, however, by the amount of the inter-company sales.

This relationship is not disturbed by sales to subsidiaries for use in constructing capital equipment since such sales are treated as outside sales and the full sales price is charged to capital account by the purchasing company and on the consolidated balance sheet of the Corporation. Only goods sold for conversion or resale are treated as inter-company items.

The fact that goods purchased by one subsidiary from another are retained in inventory or that goods sold were sold from inventory does not affect the relationship between inter-company sales and integrated costs, since adjustment is always

made to defer the taking up as profit on the consolidated profit and loss statement the profit shown by one subsidiary on sales to another subsidiary when the goods sold are still in the inventory of the second subsidiary. This profit is taken up as realized profit only when the goods are sold outside the organization. The effect of this adjustment for inter-company profit in inventory may be seen in the following series of illustrations.

Case I. Company A sells to affiliated Company B for $100 a product which cost it $80. Company B sells this product for $120. The sales and cost of goods sold set-up would be as follows:

Item	Co. A	Co. B	Consolidated	Inter-Co. Sales	Integrated Basis
Sales	$100	$120	$220	$100	$120
Cost of goods sold	80	100	180	100	80
Gross Profit	20	20	40		40

Case II. In addition to the transaction in Case I, Company A sells to Company B for $80 a product which cost it $60. Company B has this in inventory at the end of the year, and the profit shown by Company A on the second sale to Company B is treated as unrealized on the consolidated profit and loss statement because the product has not been sold outside the consolidated organization. The sales and cost of goods sold set-up would then be as follows:

Item	Co. A	Co. B	Inter-Co. Profits in Inventory	Consolidated	Inter-Co. Sales	Integrated Basis
Sales	$180	$120		$300	$180	$120
Cost of goods manufactured or purchased	$140	$180		$320	$180	$140
Less: Closing inventory		80	$20	60		60
Cost of goods sold	140	100	20	260	180	80
Gross Profit	40	20	20	40		40

Case III. In addition to the transactions in Cases I and II, Company B sells for $75 a product which it bought from Company A the previous year for $65. It had cost Company B $60 to produce this article, with the result that $5 intercompany profits tied up in inventory was deducted from consolidated gross profits in the previous year by addition to cost of goods sold in a manner similar to the $20 adjustment for inter-company profit in inventory in Case II. The sales and cost of goods sold would then be as follows:

Item	Co. A	Co. B	Inter-Co. Profits in Inventory	Consolidated	Inter-Co. Sales	Integrated Basis
Sales	$180	$195		$375	$180	$195
Opening inventory		65	$5	60		60
Cost of goods manufactured or purchased	140	180		320	180	140
Total goods available for sale	140	245	5	380	180	200
Less: Closing inventory		80	20	60		60
Cost of goods sold	140	165	15	320	180	140
Gross Profit	40	30	15	55		55

The fact that goods purchased from another subsidiary are usually further fabricated before being resold does not change the relationship. It merely adds the cost of such fabrication to the cost of goods sold by the purchasing subsidiary.

Hence the integrated cost will be the cost to the first subsidiary plus the cost of fabrication incurred by the second subsidiary. It will still be less than the cost shown on the consolidated profit and loss statement by the amount of the inter-company sales.

This may be illustrated by a situation where the first subsidiary sells a product costing $60 to the second subsidiary for $80. The second subsidiary fabricates it further at a cost of $10 and sells it to an outside purchaser for $120. The profit and loss set-up is shown below, the column headed "Consolidated", showing the figures that would appear on the consolidated profit and loss statement and the column headed "Integrated" showing the figures on an integrated basis:

Item	Co. A	Co. B	Consolidated	Inter-Co. Sales	Integrated Basis
Sales	$80	$120	$200	$80	$120
Cost of goods purchased		80	80	80	
Cost of manufacturing	60	10	70		70
Cost of goods sold	60	90	150	80	70
Gross Profit	20	30	50		50

It should be noted that the costs shown on the consolidated profit and loss statements are always in excess of integrated cost by the amount of the current year's inter-company sales. Hence it is proper to deduct from costs of goods sold as shown on the profit and loss statement the amount of the inter-company sales and revenues in order to arrive at a cost figure which is comparable with the tonnages shipped to outside purchasers.

Exhibit No. 1417

AN ANALYSIS OF STEEL PRICES, VOLUME AND COSTS CONTROLLING LIMITATIONS ON PRICE REDUCTIONS

This analysis was prepared by the United States Steel Corporation in connecton with its studies in preparation for the hearings on the steel industry before the Temporary National Economic Committee. The work was under the supervision of Theodore O. Yntema, Professor of Statistics, University of Chicago.

October 30, 1939.

Importance of Price-Volume-Cost Relationship

The success of mass production methods in American industrial practice has given much emphasis to the importance of volume in reducing costs. Failure to appreciate, in the case of the steel industry, the limitations of the extent to which increased volume means reduced costs per unit of product has frequently been made the basis of the charge that steel prices are higher than they should be and that the absence of price competition, rather than the limitations imposed by costs, is the reason why steel prices are not lower than they are. It is further said that if steel prices were lowered in times of recession more steel would be sold and payrolls and employment would be better maintained. The fact of the matter is that steel prices are not high. In recent years they have barely covered costs. In the last ten years, 1929 to 1938, the United States Steel Corporation realized a return of only 1.9% on the combined investment of the bondholders and stockholders. From 1930 to 1938 its rate of return has averaged less than 1%.

However, the contention that steel prices are too high is not made in ignorance of the small margin of profit currently being realized. The theory of those who would lower steel prices is that such reductions would greatly stimulate sales and that volume and costs are so interrelated in the production of steel that the cost per ton would be drastically reduced if volume were increased. Hence, it is argued that if prices were decreased even below present costs, volume would be stimulated to a point where costs would drop sufficiently to make steel production profitable at the reduced prices. In determining whether or not this is so, two all important factors must be considered. They are (1) the amount by which unit costs do in fact shrink as volume increases and (2) the amount by which volume is in fact increased by lowering prices.

COSTS AND VOLUME

It would have been possible to obtain some idea of the way in which the total costs of the United States Steel Corporation and its subsidiaries increase with increases in output simply by comparing total costs shown on its consolidated annual profit and loss statements over a period of years with the tonnage of rolled and finished products shipped each year. Such an analysis would not be wholly accurate, however, for several reasons.

In the first place, the total costs for the same number of tons shipped would differ depending upon the type of product whose tonnage predominated. For instance, if the shipment figures showed that in each of two years 10,000,000 tons had been produced, the costs would naturally be higher in the year in which high cost products, such as sheets and tin plate, constituted the larger portion of the tonnage, than in a year when lower cost items, such as rails and heavy plates, predominated. In the following analysis this difficulty has been adjusted for by computing for each year a tonnage figure representing what the equivalent gross tonnage, from a cost standpoint, would have been if the total shipments were constituted of normal proportions of high and low cost products. Similarly, the total tonnage of rolled and finished products shipped has been adjusted to include the equivalent gross tons of steel represented by the products other than steel which are sold on a tonnage basis by the Corporation's subsidiaries.

Secondly, the cost figures taken from the profit and loss statements represent costs in different years when different wage rates, interest rates, tax rates and prices prevailed. Hence, it is necessary to adjust the cost figures for years prior to 1938 to conditions prevailing in 1938 in order to ascertain what the relation between costs and volume would be as of 1938, the most recent full year and the one in which material prices, pension payments, and wage, interest, and tax rates are most representative of present-day conditions.

Since different adjustments are necessarily required for different types of costs, the total costs of the Corporation and its subsidiaries, exclusive of inter-company items and costs connected with extraneous non-operating transactions, for each of the years 1927 to 1938 were broken down into (1) interest, (2) pensions, (3) depreciation and depletion, (4) taxes other than social security and Federal income and profits taxes, (5) payroll, (6) social security taxes, and (7) other expenses. Each of these costs as they appeared in past years has been separately adjusted to the levels of 1938.[1] Federal income taxes have been omitted from the computations because they depend upon profits rather than volume and it was the purpose of this analysis to work out a cost-volume relationship which can be compared to total sales and revenues at various price and volume levels.

The total costs obtained by adding together the adjusted items for each year represented what the costs would have been in those years if 1938 prices and interest, wage, and tax rates had prevailed. A further adjustment was then made, based on the downward trend of costs in relation to volume over the period of time involved, to take into consideration the extent to which the same tonnages could have been produced in 1938, because of increased efficiency, at lower cost than they could have been produced in prior years at 1938 prices, pensions and wage, interest, and tax rates.

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[1] The adjustments applied to each of the cost factors enumerated were as follows:

(1) *Interest*—The interest cost, not being dependent on volume, was converted to 1938 conditions by substituting the 1938 interest charge in the figures for each year.

(2) *Pensions*—The cost of pensions, like interest, was converted to 1938 conditions by substituting the 1938 figure.

(3) *Depreciation and Depletion*—Since there has been no important change in the Corporation's accounting policy, no adjustment has been made in the depreciation and depletion figures.

(4) *Taxes Other than Federal Income and Profits Taxes and Social Security Taxes*—Since analysis of the relation of taxes to volume discloses that the taxes for 1932 onward follow one pattern while the taxes for previous years were considerably lower, adjustment was made for the changed tax laws by substituting in prior years the taxes for the volume involved which were indicated by the 1932–1938 line of average relationship between taxes and volume.

(5) *Payroll*—The payrolls for each of the respective years were adjusted to 1938 rates on the basis of the proportionate change in the average hourly earnings between the year in which the payroll was incurred and 1938.

(6) *Social Security Taxes*—Social security taxes at 1938 rates for the various amounts of payroll were estimated by applying the 1938 ratio of these taxes to payroll.

(7) *Other Expenses*—This item consists largely of goods and services purchased from others. An approximate adjustment for the changing prices of these items which the Corporation must purchase has been made on the basis of the Bureau of Labor statistics index of wholesale prices for commodities other than food and farm products. While low operating rates are usually accompanied by somewhat lower material prices, material costs were adjusted to 1938 price levels in this study in order to ascertain the changes in unit costs which would be attributable to changes in volume alone.

The final adjusted costs and the weighted tonnages to which they are related are as follows:

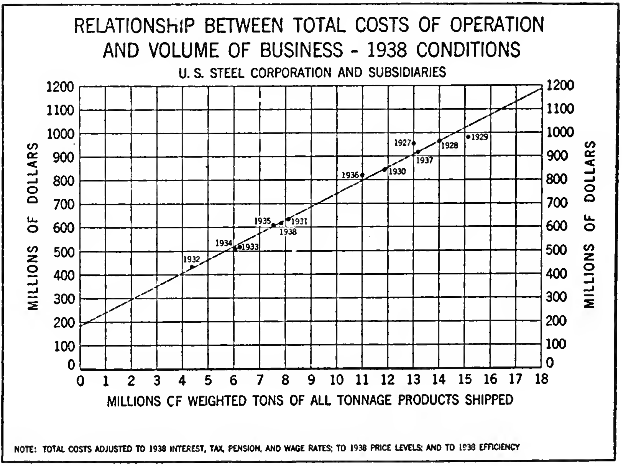
TABLE 1.—*Total Costs and Volume of Business—1938 Conditions* [1]*—United States Steel Corporation and All Subsidiaries*

Millions of Weighted Tons of Products Shipped	Costs—1938 Conditions (Millions of Dollars)	Year on which Estimate is Based	Millions of Weighted Tons of Products Shipped	Costs—1938 Conditions (Millions of Dollars)	Year on which Estimate is Based
4.4	436.0	1932	11.0	818.2	1936
6.1	510.0	1934	11.9	838.8	1930
6.2	512.0	1933	13.0	954.5	1927
7.6	610.3	1935	13.2	916.2	1937
7.8	614.3	1938	14.0	966.2	1928
8.1	628.9	1931	15.1	979.0	1929

[1] Total costs are adjusted to 1938 interest, pension, wage, and tax rates, to 1938 price level, and to 1938 efficiency.

These costs have been plotted in relation to the volume of shipments on Chart 1. Insertion of the straight line established by the respective points shows the average relationship between volume and cost under 1938 conditions. The smallness of the vertical deviations of the various points from this line of average relationship indicates how closely the costs of the United States Steel Corporation and its subsidiaries follow this pattern.

CHART 1



Mathematical computation of the cost relationship indicated by the cost line shows that the total costs of the Corporation and its subsidiaries amount to $55.73 per weighted ton,[2] plus $182,100,000.[3] The $182,100,000 represents the

[2] The total weighted tonnage shipped does not include the volume of goods and services sold on other than a tonnage basis. This additional cost of $55.73 represents the additional cost of all goods and services shipped or sold per weighted ton of tonnage products shipped.

[3] A similar analysis of the unadjusted costs shows that the average relationship prevailing during the period 1927–1938 between costs and volume was such that total costs tended to be $54.51 per weighted ton plus $120,530,000. If these figures were substituted for those based on the adjusted costs, the calculations which are to follow would be changed considerably, but the general conclusions as to the increase in volume needed to offset a price decrease would remain unaffected.

portion of the costs which remains the same, regardless of the volume of steel produced, as long as the Corporation's subsidiaries are operating at all. Such costs are frequently termed "fixed costs" or "overhead costs." The $55.73 per weighted ton represents the additional cost of the increased operations incidental to each successive weighted ton of product shipped. Such costs are termed "variable costs," "incremental costs," or "additional costs." In the case of the Corporation these additional costs remain constant at $55.73 per ton through the range of volume within which the Corporation's subsidiaries operated from 1927 to 1938. While additional costs might possibly vary if facilities were pressed to the absolute limit, or if operations fell to a point even lower than they did in the depth of the depression in 1932, the 1927–1938 experience includes annual rates of operation varying from 17.7% to 90.4% of ingot capacity.

Although the increase in costs with each additional ton of steel produced tends to remain constant, this does not mean that the average cost per ton of steel remains the same. Since the average cost amounts to $55.73 per ton plus the pro rata portion of fixed costs and since the $182,100,000 of fixed costs can be distributed over more units as production is increased, the average cost of operations per ton of steel shipped will obviously decrease as volume rises.

It should be noted here, however, that while the costs mentioned are exclusive of all non-operating income and expense, they cover all operations of the United States Steel Corporation and its subsidiaries and, hence, do not represent merely the cost of producing steel. Furthermore, even weighted tonnages shipped do not reflect the full volume of business, since some goods and services are sold by the Corporation's subsidiaries which are not measured in tons. Nevertheless, other operations rise and fall with increases and decreases in shipments of products to a sufficient extent that the total costs maintain approximately the relationship to shipments just described.

An analysis of the elements composing the fixed and the additional costs discloses that they are composed as follows:

TABLE 2.—*Elements of Total Costs 1938 Conditions—United States Steel Corporation and all Subsidiaries*

Item	Costs that must be met regardless of operating rate	Additional cost for each additional weighted ton of product shipped
Interest	$8,300,000	$0.00
Pensions	7,700,000	0.00
Taxes other than Social Security and Federal Income	24,200,000	1.43
Payroll	62,100,000	29.10
Social Security Taxes	2,500,000	1.16
Other Cash Expenses	47,800,000	21.67
Total Cash Costs	$152,600,000	$53.36
Depreciation and Depletion	29,500,000	2.37
Total Costs	$182,100,000	$55.73

The relationship of the various elements of cost to volume is graphically portrayed in Chart 2. It is worthy of note that not only does payroll constitute the largest item of additional costs but it is also the largest element of the overhead or fixed costs, amounting to over one-third of that item.

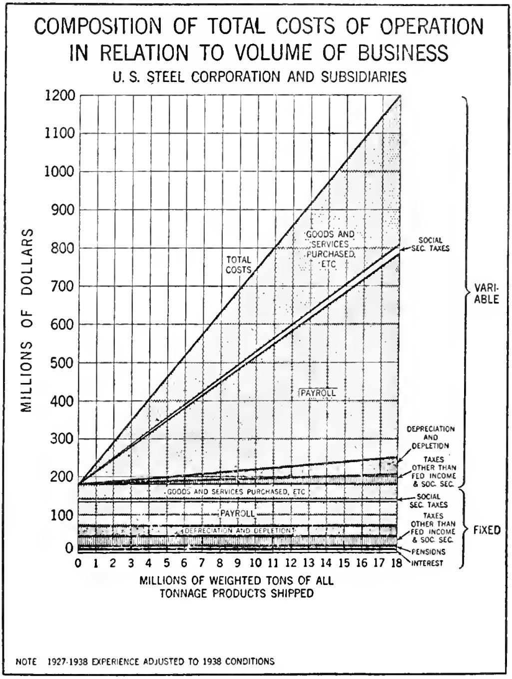
PRICES AND VOLUME

If the relationship between volume and costs is known, it becomes possible to determine the increase in volume that would be needed as the result of a price reduction in order to offset the decreased amount received for each unit of product sold, assuming no reduction in wage rates, material prices, and other such factors. Similarly, to the extent that it is possible to estimate the increase in volume that would be likely to result from a price decrease, it is possible to estimate what is to be gained or lost by reducing prices.

In connection with the increase in volume that would be attained through a price reduction, it must be remembered that if any substantial increase results, it will have to result from an increase in the total amount of steel consumed, since competitive meeting of prices will generally prevent any sustained increase in the

participation of the United States Steel Corporation and its subsidiaries in the going volume of business. On the other hand, the rise to be expected in the total volume of steel consumed as a result of a drop in prices is not very great in the steel industry. Steel is not sold directly to the ultimate consumer. It reaches him only as a part of the finished automobile, typewriter, apartment house, tin can, or safety pin, as the case may be. In other cases, steel is used only as part of the machinery and equipment used in making the products which reach the man in the street. No matter how low the price, steel can be sold only if products which are produced from steel or by the use of steel are being sold. In the case of products produced from steel, the cost of steel is usually so small a fraction of the

CHART 2



total cost of the product that a reduction in steel prices, even if passed on to the ultimate consumer, would not result in a sufficient decrease in the price of the finished product to cause an appreciable increase in its sale. As far as steel for production is concerned, it is evident that regardless of the price of steel no one will invest in productive machinery unless he feels the prospects in his particular line of business justify such investment.

Analysis of the influence of price as a factor affecting steel consumption in the automobile, railroad and container industries reveals that a decrease in the price of steel can increase the consumption of steel only to a limited extent by promoting the use of more steel per unit or permitting steel to be substituted for some other competing material. Any substantial increase in the consumption of steel in these industries could be brought about only by increasing the consumption of the finished product or service rendered. Consequently, the price elasticity of the

demand for steel depends primarily upon the price elasticity of demand for the finished product and the relative cost of steel to the price of the finished product.

The elasticity of demand is measured by the ratio of the relative resulting increase in volume to the relative decrease in price. For example, in the case of automobiles, an exhaustive study by Messrs. Roos and von Szeliski [4] showed that the price elasticity of demand for automobiles was about 1.5, which means that a 1% reduction in price would increase the number of automobiles sold about 1.5%. Since the cost of steel in the form sold by the steel producer is about one-tenth of the retail price of a representative low-priced automobile, it follows that a reduction of 10% in the price of steel, even if passed on to the ultimate consumer, could effect at most only a 1% reduction in the price of the delivered automobile, which, as has been stated, could bring about but a 1.5% increase in the number of automobiles sold and in the amount of steel used in the automobile industry. The increased consumption arising out of the extent to which steel might be substituted for some other material, or the extent to which the use of steel per automobile might be increased if steel prices were reduced, would probably not increase the elasticity by more than .1. Taking into account all factors and making a liberal allowance for possible error, elasticity of demand for automotive steel is not in excess of .2 or .3.

The price elasticities for the finished products or services in the container, and railroad industries have not had the benefit of as definite measurement as that made of the demand for automobiles by Messrs. Roos and von Szeliski, but the evidence indicates that the demand for these products is considerably less elastic than the demand for automobiles. Moreover, analyses of all the factors influencing steel consumption in these industries, even assuming an elasticity of demand for the finished products and services as high as 2, show definitely that the price elasticity of the demand for steel in each of the respective industries is considerably less than 1. A mathematical analysis of the correlation between the amount of all steel sold and the various factors, including price, which influence the quantity sold, reveals that a negligible portion of the fluctuations in the quantity sold are attributable to price and that a steel price change, other factors remaining unchanged, will not result in as great a percentage change in the volume of steel sold. This confirms the individual analyses of the principal steel consuming industries already mentioned.

While the above analyses indicate clearly that the elasticity of the demand for steel is considerably less than 1, it has been assumed for the purposes of this study, in order to use a figure that is beyond question, that the elasticity of demand for steel is as high as 1. An elasticity of 1 means that any decrease in price will result in a proportional increase in volume which will keep the total sales in dollars unchanged. This is to say that for small changes in price a given percentage decrease, such as a 5% reduction in price, will result approximately in the same percentage increase in volume sold.

The Effect of Price Reductions

It is evident that unless the elasticity of demand for the product exceeds 1 by a substantial margin, the theory that price reduction in and by itself would produce profits through increased volume is utterly fallacious, not only for the United States Steel Corporation, but for any business or any industry. Since, with the elasticity of demand equalling 1, the total sale receipts would remain the same, for the theory to work the total costs of producing the greater volume would have to be the same or less than the amount required to produce the original volume. No increased payroll could be incurred to produce the greater volume, for example. Such a condition could exist only when all costs were "fixed" or "overhead" and none were "additional" or "variable". Only then would the cost per unit go down, relatively, as fast as the volume went up. Application of the theory of increased profits through price reduction when the elasticity of demand for the product is 1 or less could thus result only in loss to the enterprise which adopted it. The actual amount to be lost by reducing steel prices, however, and amount by which the increase in volume to be expected as a result of reducing steel prices falls short of the increase needed to offset the price reduction, can be estimated only by including in the computation the relationship which exists between costs and volume.

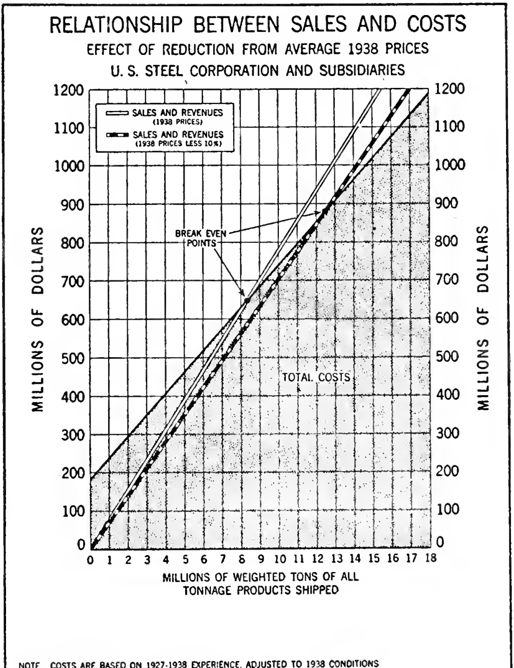
The sales and revenues of the United States Steel Corporation's subsidiaries in 1938 amounted to $77.66 per weighted ton of products shipped. Of this amount $71.86 represented the amount received from the sale of goods and $5.80 represented revenues from transportation and miscellaneous operations.

[4] C. F. Roos and Victor von Szeliski, "Factors Governing Changes in Domestic Automobile Demand." *The Dynamics of Automobile Demand*, General Motors Corp'n, N. Y., 1939.

On Chart 3, the line representing total costs as volume varies is compared to the corresponding amount of total sales and revenues at the 1938 amount per weighted ton. This relationship indicates that the break-even point at 1938 average prices was at 8.3 million weighted tons. This is equivalent to an operating rate of 40% to 45% of capacity, depending upon the type of products constituting the total products shipped.

A price decrease of 10% from the average 1938 prices, assuming that the amount per weighted ton received from transportation and other operations remains unchanged, would result in total sales and revenues as represented by the dashed line in the chart.[5] The result of such a price reduction would be to

CHART 3



raise the break-even point to 12.36 million weighted tons, an increase of 48.8%, which should be contrasted with the 11% increase in volume which is the maximum that might be expected from a 10% price decrease. The same relationship holds not only with regard to the break-even point, but also with regard to the netting of any particular amount of profit or loss. For instance, if production amounted to 6,000,000 weighted tons, the loss at 1938 average prices would be about $50,500,000. If average 1938 prices were decreased 10%, volume would have to be raised 48.8% to about 8,925,000 weighted tons in order not to increase the loss.

In this discussion it has been assumed that the revenues from transportation and miscellaneous operations would increase sufficiently as the production of

[5] The reduction has been made in the $71.86 representing 1938 sales per weighted ton, but not in the $5.80 per weighted ton representing transportation and miscellenaous revenue.

steel increased so as still to amount to $5.80 per ton. The general tendency of these revenues has been to rise and fall approximately as product shipments go up and down, but in recent years there has been a tendency for them to fall off somewhat per ton of products shipped when the higher levels of production are reached. To the extent that revenues from transportation and miscellaneous operations might fail to increase proportionately with increases in shipments, the increases in volume needed to compensate for the various price decreases would be even greater than those stated.

The impracticability of attempting to raise volume from recession to prosperity levels by means of price decreases may be seen from the effect of the price reduction that would have been needed to bring the 1938 volume of the Corporation's subsidiaries up to 1937 levels. Such an increase would have been from 7,800,000 to 13,200,000 weighted tons, a rise of 69.23%. Since steel has at best an elasticity of demand of 1, such an increase could have been brought through price reduction, if at all, only by a price decrease of at least 40.9%, reducing sales per weighted ton from $71.86 to $42.46.[6] Disregarding the possibility that other operations might not expand with increased shipments and adding in the full $5.80 per weighted ton realized from other operations at actual 1938 volume, the total sales and operating revenues would then have amounted to $48.26 per weighted ton. Since the variable cash costs amount to $53.36 per weighted ton, the Corporation's subsidiaries would have sustained a cash loss of $5.10 on every weighted ton sold in addition to failing to recover any part of the fixed cash costs of $152,600,000. Assuming that the price reduction would have been successful in restoring the 1937 volume, 13,200,000 weighted tons would have been sold. At a loss of $5.10 a ton, plus $152,600,000 fixed costs not covered by the sales price, the Corporation and its subsidiaries would have had a cash loss for the year of $219,920,000. This is without making any provision for depreciation and depletion of fixed assets. The drain of such a cash loss upon the Corporation and its subsidiaries, if continued, would have exhausted their 1938 average working capital in less than two years. If the amount of the depreciation and depletion of assets at this volume of operations, amounting to $60,784,000, is added to the cash loss, there is a total loss of $280,704,000. Annual losses at this rate would wipe out the combined equity of the preferred and common stockholders as of December 31, 1938, in about four and a half years.

While a smaller decrease in price could not have been expected to raise the 1938 volume to the 1937 level, it may nevertheless be contended that some price reduction and some resulting stimulation in volume were desirable. At 1938 average prices, however, the increase in volume which would take place even if the elasticity of demand in steel were as high as 1 would be far short of the percentage increase needed to prevent additional loss. The increases in volume needed to offset various percentage reductions in price and the maximum probable increase in volume which would result are as follows:

TABLE 3.—*Increases in Volume Needed to Compensate for Various Decreases in Average 1938 Prices—Compared to Probable Resulting Increases in Volume—United States Steel Corporation and Subsidiaries*

Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1	Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1
1	3.4	1.0	10	48.8	11.1
2	7.0	2.0	11	56.4	12.4
3	10.9	3.1	12	64.8	13.6
4	15.1	4.2	13	74.2	14.9
5	19.6	5.3	14	84.8	16.3
6	24.5	6.4	15	96.7	17.7
7	29.8	7.5	20	190.3	25.0
8	35.5	8.7	25	453.6	33.3
9	41.8	9.9	30	5,858.2	42.9

The divergence between the needed increase in volume and the maximum probable resulting increase, based on an elasticity of 1, is illustrated in Chart 4.

The following tabulation sets forth what the additional loss in dollars to the United States Steel Corporation and its subsidiaries would have been if the 1938

[6] If the elasticity of demand were 1, the total sales in dollars would remain unchanged by price reductions since volume would increase to a compensating extent. Hence dividing the 1938 sales of $560,508,000 by 13,200,000 will give the average price at which steel would have to have been sold to have shipped 13,200,000 weighted tons in 1938.

average prices had been reduced various percentages. Separate estimates have been made showing the additional loss if the maximum probable increase in volume resulted and if no increase in volume resulted from the price reduction. The actual loss would have to fall somewhere between these two limits.

CHART 4

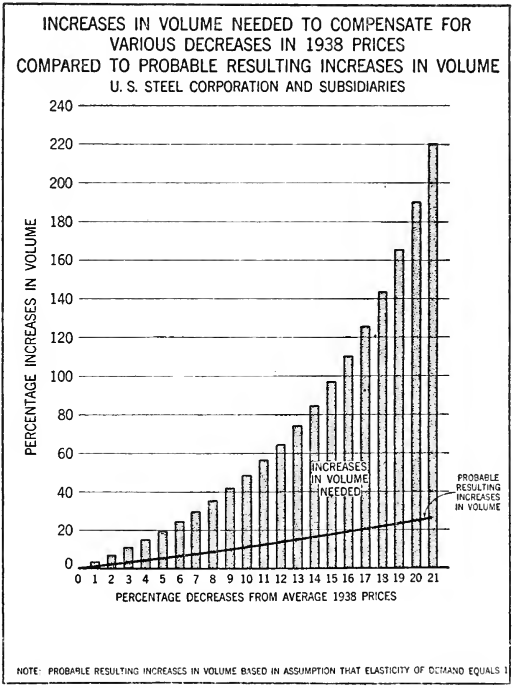


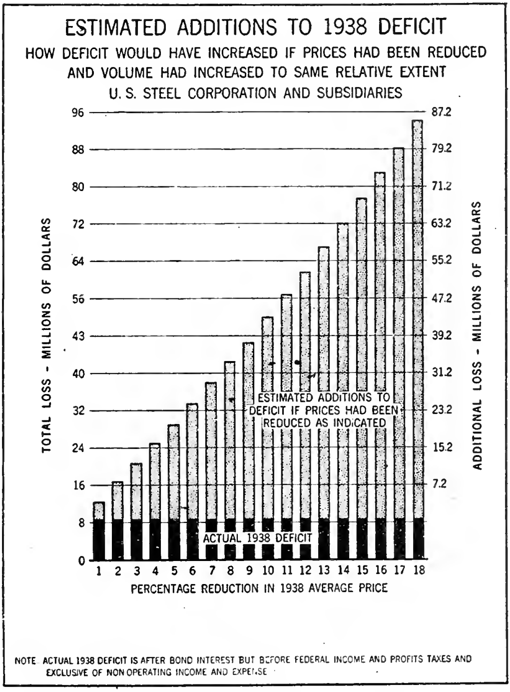
TABLE 4.—*Estimated Additions to 1938 Deficit—How Deficit Would Have Increased if Average 1938 Prices Had Been Reduced—United States Steel Corporation and Subsidiaries*

Percentage Reduction in Price	Estimated Addition to Deficit Assuming Elasticity of Demand for Steel of 1	Estimated Addition to Deficit if No Increase in Volume Resulted from Price Reduction	Percentage Reduction in Price	Estimated Addition to Deficit Assuming Elasticity of Demand for Steel of 1	Estimated Addition to Deficit if No Increase in Volume Resulted from Price Reduction
1	$3, 900, 000	$5, 600, 000	11	48, 100, 000	61, 700, 000
2	7, 900, 000	11, 200, 000	12	53, 100, 000	67, 300, 000
3	12, 000, 000	16, 800, 000	13	58, 200, 000	72, 900, 000
4	16, 200, 000	22, 400, 000	14	63, 400, 000	78, 500, 000
5	20, 500, 000	28, 000, 000	15	68, 700, 000	84, 100, 000
6	24, 900, 000	33, 600, 000	16	74, 200, 000	89, 700, 000
7	29, 300, 000	39, 200, 000	17	79, 800, 000	95, 300, 000
8	33, 900, 000	44, 800, 000	18	85, 500, 000	100, 900, 000
9	38, 500, 000	50, 400, 000	19	91, 400, 000	106, 500, 000
10	43, 300, 000	56, 100, 000	20	97, 400, 000	112, 100, 000

The 1938 operating deficit, before Federal income tax, and the additional losses that would have resulted from price reductions if volume increased to the same relative extent that prices decreased, are illustrated in Chart 5.

Since the average 1938 prices represent the average results of prices in effect both before and after the June 24, 1938, reduction in the price of steel products, Chart 6 has been constructed to show the relationship between annual sales and revenues and annual costs at various levels of production if the prices prevailing in the second half of 1938 had prevailed over the entire year.[7] At such a price

CHART 5



level the break-even point for the United States Steel Corporation and its subsidiaries would be at about ten and a half million of weighted tons, which is equivalent to an operating rate of 50% to 55% of capacity, depending on the type of products predominating. A 10% reduction in prices at this level would result in sales and revenues indicated by the dashed line in Chart 6. The total sales and revenues would then reach the amount of the total costs only if operations were around 90% of capacity. If the break-even point were this high, the Corporation's subsidiaries would have to operate at the impossible annual rate of over 130% of capacity to earn a return, before income taxes, as modest as 5% on their investment in tangible assets.

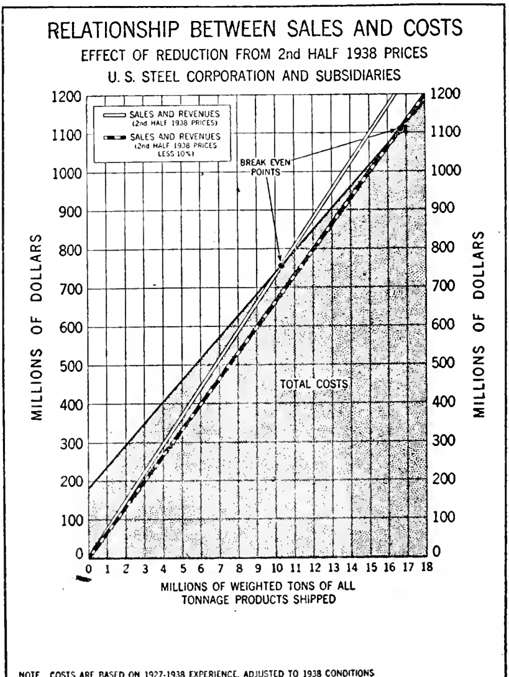
[7] The amount of sales and revenues per weighted ton if the prices prevailing in the second half of 1938 had prevailed throughout the entire year has been estimated by reducing the sales per weighted ton proportionately to the extent to which the selling value per weighted ton of rolled and finished steel products shipped during the second half of 1938 was less than the average selling value of rolled and finished products for the entire year.

The percentage increases in volume required to offset a given percentage decrease in the average price prevailing in the second half of 1938, as shown in Table 5 below, would be even greater than those needed at the average level of prices for 1938 as a whole.

TABLE 5.—*Increases in Volume Needed to Compensate for Various Decreases in 2nd Half, 1938, Prices Compared to Probable Resulting Increases in Volume—United States Steel Corporation and Subsidiaries*

Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1	Percentage Reduction in Price	Percentage Increase in Volume Needed	Probable Percentage Increase, Assuming Elasticity of 1
1	4.0	1.0	10	63.1	11.1
2	8.4	2.0	11	74.1	12.4
3	13.1	3.1	12	86.7	13.6
4	18.3	4.2	13	101.3	14.9
5	24.0	5.3	14	118.3	16.3
6	30.2	6.4	15	138.4	17.7
7	37.2	7.5	20	342.6	25.0
8	44.8	8.7	25	2984.4	33.3
9	53.5	9.9			

CHART 6



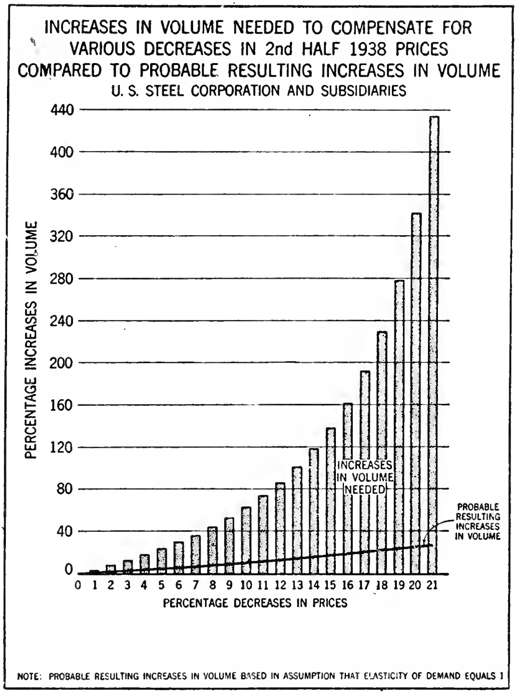
The divergence between the needed increase in volume and the maximum probable increase to result from a reduction in the prices prevailing in the second half of 1938 is graphically portrayed on Chart 7.[8]

The inter-relationship between prices and sales, costs, and volume for the United States Steel Corporation and its subsidiaries, then, is such that the increase in volume required to offset a price decrease is far greater, than the price reduction could be expected to stimulate. Hence, in times of recession the Corporation and its subsidiaries, unhappily, do not have the alternative of lowering their prices, moving their goods and employing their workers. Reduction of prices beyond that necessary to meet competition and keep their share of the going business, can result only in severely increasing the financial losses which are incurred in such periods. Instead of prosperity, undiminished employment, and undiminished payrolls in the steel industry, only bankruptcy, unemployment and dwindling payrolls would result from further price reduction.

[8] While the assumption of any elasticity of demand for steel greater than 1 is highly unrealistic, it is interesting to note that even if steel had an elasticity of 1.5 or 2, the percentage increase in volume needed to offset a price reduction would still greatly exceed the percentage increase in volume which would then result from reducing prices:

Decrease in Price	Resulting Increase in Volume		Increase in Volume Needed to Offset:	
	If Elasticity= 1.5	If Elasticity= 2	Decrease in Average 1938 Steel Prices	Decrease in 2d Half 1938 Steel Prices
1%	1.5%	2.0%	3.4%	4.0%
2	3.1	4.1	7.0	8.4
3	4.7	6.3	10.9	13.1
4	6.3	8.5	15.1	18.3
5	8.0	11.1	19.6	24.0
10	17.1	23.5	48.8	63.1
15	27.6	38.4	96.7	138.4
20	39.8	56.3	190.3	342.6
25	54.0	77.8	453.6	2984.4
30	70.8	104.1	5858.2	(No increase sufficient)

CHART 7



"EXHIBIT No. 1418" is included in Hearings, Part 27, appendix, p. 1419.

EXHIBIT No. 2180

THE DISTRIBUTION OF STEEL TO MAJOR CONSUMING INDUSTRIES

This is an analysis prepared by the Special Economic Research Section of United States Steel Corporation, composed of Messrs. Edward T. Dickinson, Jr., Ernest M. Doblin, H. Gregg Lewis, Jacob L. Mosak, Mandal R. Segal, Dwight B. Yntema and Miss Marion W. Worthing. The work of this group was under the supervision of Theodore O. Yntema, Professor of Statistics, University of Chicago. This analysis was written by Marion W. Worthing and has had the benefit of suggestions from other members of the staff. It is issued by United States Steel Corporation.

OCTOBER 30, 1939.

DESCRIPTION OF THE PROBLEMS

The table presented on pages 2 and 3 of this memorandum shows yearly estimates of the tonnage of steel production destined for each of the major consuming industries from 1923 to 1938. The estimates presented in this table have been prepared because statistics covering the full distribution of either production or shipment from year to year are not available.

Estimates of the amount of steel distributed to the major consuming industries have been published every year since 1922 or 1923 by *Iron Age* and *Steel* magazines. These estimates are based on annual reports by individual steel producers of shipments of the major classes of steel products to each type of consumer. Although each trade journal sends out its own requests for data to the steel producers, the information asked for and received by each publication is similar. The figures published by each of these magazines have been used in this study. Because of variable coverage of firms from year to year, and because of ambiguities and variations in classifications, the tabulations resulting from the combination of the reports of the contributing steel companies do not represent accurately the distribution of steel by consuming industries.

In an attempt to remedy some of the defects in the original shipment tables, a series of adjustments have been made which will be presented in detail later in this report but which may be described here briefly as follows:

1. Distribution percentages derived from the original *shipment* data were applied to hot-rolled steel *production* in order to secure comparability of the totals among the different years, i. e., the percentage distribution of the shipments of each class of product to the major industries was applied to the production of the most nearly comparable hot-rolled products.
2. Production indicated for jobbers, warehouses, and similar distributors was reallocated to the appropriate consuming industries on the basis of the informed opinion of a number of persons concerned with the sale of merchant products.

Distribution of Production of Hot-Rolled Iron and Steel Products to Major Consuming Industries, 1923–1938, On the Basis of Distributions of Shipments Published in Iron Age and Steel

[Thousands of gross tons]

Year	Total Production of Hot-Rolled Iron and Steel Products	Automotive		Agriculture		Railroads		Construction		Shipbuilding		Containers (light)	
		Iron Age	*Steel*	*Iron Age*	*Steel*	*Iron Age*	*Steel*	*Iron Age*	*Steel*	*Iron Age*	*Steel*	*Iron Age*	*Steel*
1923	33,277	[1] 4,182	(2)	[1] 1,345	(2)	[1] 8,424	(2)	[1] 4,935	(2)	[1] 291	(2)	[1] 1,205	(2)
1924	28,086	[1] 2,981	(2)	[1] 882	(2)	[1] 7,196	(2)	[1] 4,800	(2)	[1] 231	(2)	[1] 1,210	(2)
1925	33,387	[1] 4,886	(2)	[1] 1,129	(2)	[1] 7,809	(2)	[1] 5,539	(2)	[1] 305	(2)	[1] 1,427	(2)
1926	35,496	5,486	(2)	1,804	(2)	7,656	(2)	6,274	(2)	307	(2)	1,348	(2)
1927	32,879	4,895	4,543	1,774	2,312	6,232	6,347	6,947	6,984	397	292	1,408	1,484
1928	37,663	6,963	6,833	2,659	3,239	6,119	6,269	7,060	6,958	180	220	1,619	1,676
1929	41,069	6,565	7,306	2,733	3,081	7,288	7,751	7,717	7,330	309	372	1,707	1,832
1930	29,513	4,406	4,272	1,526	2,118	4,679	4,941	6,567	6,274	331	390	1,670	1,626
1931	19,176	3,149	3,030	1,205	1,210	2,710	2,834	4,097	4,260	200	227	1,415	1,397
1932	10,451	1,864	2,060	540	616	1,050	994	2,404	2,352	91	106	1,037	1,000
1933	16,735	3,530	3,732	990	1,027	1,317	1,411	2,644	2,823	103	117	1,759	1,711
1934	18,970	4,101	4,351	1,101	891	2,271	2,374	3,175	3,179	208	207	1,557	1,497
1935	23,965	6,016	5,947	1,764	1,790	1,751	1,843	3,853	3,850	185	194	2,039	1,966
1936 [3]	33,801	6,712	7,416	1,998	2,107	3,645	3,713	5,775	5,971	257	281	2,455	2,472
1937	36,766	6,977	7,882	2,085	2,207	4,184	4,222	5,391	5,523	349	386	2,874	2,954
1938	20,986	3,619	3,871	991	1,011	1,289	1,337	3,927	4,379	348	74	1,908	2,047

See footnotes at end of table.

Distribution of Production of Hot-Rolled Iron and Steel Products to Major Consuming Industries, 1923–1938, On the Basis of Distributions of Shipments Published in Iron Age and Steel—Continued

[Thousands of gross tons]

Year	Machinery		Mining		Oil, gas, and water		Exports		Furniture and furnishings		Miscellaneous	
	Iron Age	*Steel*	*Iron Age*	*Steel*	*Iron Age*	*Steel*	*Iron Age*	*Steel*	*Iron Age*	*Steel*	*Iron Age*	*Steel*
1923	[1] 1,043	(2)	(4)	(2)	[1 4] 3,503	(2)	[1] 2,036	(2)	(5)	(2)	[1 5] 6,313	(2)
1924	[1] 1,006	(2)	(4)	(2)	[1 4] 2,572	(2)	[1] 1,793	(2)	(5)	(2)	[1 5] 5,416	(2)
1925	[1] 1,352	(2)	(4)	(2)	[1 4] 2,850	(2)	[1] 1,771	(2)	(5)	(2)	[1 5] 6,323	(2)
1926	1,137	(2)	289	(2)	3,259	(2)	2,404	(2)	(5)	(2)	[5] 5,536	(2)
1927	1,045	1,037	306	247	2,601	2,588	2,127	1,751	(5)	282	[5] 5,147	5,011
1928	1,612	1,446	238	314	2,611	3,363	2,462	2,278	504	785	5,635	4,288
1929	1,811	1,694	288	357	3,388	3,904	2,228	2,075	625	1,070	6,405	4,296
1930	1,198	1,228	179	211	2,714	3,086	1,405	1,312	574	918	4,262	3,141
1931	706	727	108	169	1,430	1,713	839	820	368	529	2,953	2,259
1932	394	393	73	78	568	611	389	360	167	351	1,873	1,532
1933	698	693	105	114	914	952	667	612	518	665	3,491	2,878
1934	737	787	130	149	1,153	1,216	1,079	1,009	595	728	2,859	2,583
1935	974	1,199	111	170	1,325	1,353	1,063	970	1,130	1,085	3,753	3,598
1936 [3]	1,500	1,892	157	213	2,239	2,288	1,400	1,303	1,413	1,344	6,250	4,807
1937	1,611	2,028	161	216	2,548	2,589	2,708	2,564	1,334	1,267	6,546	4,936
1938	742	843	65	83	1,560	1,623	1,565	1,654	775	775	4,192	2,986

[1] Includes allocations of jobber shipments made by *Iron Age*.
[2] Data not available in a form suitable for these computations.
[3] *Iron Age* figures in 1936 have been interpolated on the basis of *Steel* figures in 1935, 1936 and 1937 and adjusted to equal the total production of hot-rolled iron and steel products in 1936.
[4] Mining, lumbering and quarrying was combined with oil, gas, and water in 1923, 1924, and 1925.
[5] Furniture and furnishings were included in miscellaneous from 1923 to 1927 incl.

Source: Computed from distribution figure published in various numbers of *Iron Age* and from production data published in the American Iron and Steel Institute's *Annual Statistical Reports*.

SUMMARY AND EVALUATION OF RESULTS

The final series presented in the accompanying tables represent the annual domestic hot-rolled steel production estimated to have been consumed eventually by the major steel consuming industries, either as hot-rolled steel or in further finished forms. The products destined for export are included in a separate group in these tabulations but the consumption of imported iron and steel is not included in the table.

The total estimated consumption of hot-rolled steel by industry groups is shown as computed on the basis of both *Iron Age* and *Steel* data. It is impossible to determine whether the results based upon *Iron Age* or those based on *Steel* are more reliable. Because of the confidential nature of the data from reporting companies, there is no chance to judge the accuracy of the methods used in making either magazine's compilations. By comparing the movements of these consumption series with other measures of activity in the various industries, it is possible that some evaluation may be made of particular estimates. This process, however, is difficult, time-consuming, and subject to error.

Although the final series retain some of the deficiencies which were inherent in the basic data, it is nevertheless reasonable to state that the adjusted figures are in most respects more useful and more trustworthy than the original ones. In the first place, by allocating total hot-rolled steel production to industry classes on the basis of reported shipments, the resulting series become comparable from year to year. Further, because the secondary distribution of steel does not follow the same pattern as that typical of direct shipments from the mills to the consumers, it is more realistic to make an approximate allocation of jobber tonnages to industries that customarily buy from those sources than to ignore such distribution. In many instances a comparison of the estimated distribution calculated from figures based on *Iron Age* and *Steel* show consistent results. Where the discrepancies between the figures are large the variation can be accounted for in some instances by differences in industry classifications used by the compilers of the original data.

Adjustment Procedures

NOTE ON THE DISTRIBUTION DATA PUBLISHED BY IRON AGE AND STEEL

The compilation of steel shipment data was started by both *Iron Age* and *Steel* in about 1922. Since it was not possible for the trade journals to get very complete coverage in the earlier years, the figures for the first two or three years are rather heavily weighted with data for the subsidiaries of United States Steel Corporation. Even now, a few small companies do not report their shipments. The coverage was improved rather rapidly but at no time has it been complete nor has it been the same from year to year. Although the published tables are often described as representing a specified percentage of the steel industry's ingot producing or finishing capacity, it is not possible to use these percentages as bases for raising the tonnage figures to an assumed 100 percent because the shipments of certain products were more completely reported than others. Until 1938, each publication was anxious to print the distribution table in its annual statistical number, the first issue in January. Since shipment data for the entire preceding calendar year could not be collected before this publication date, the steel producers reported estimated shipments for December or for both November and December. It is probable that these estimates, did not deviate seriously in relative distribution by industries from the shipments actually going to consumers. In 1937 and 1938 the tabulations were delayed so as to allow for more complete reports. Every year, each publication has made it a practice to publish some data for preceding years, presumably for purposes of comparison. Unfortunately, the components of these figures and percentages for the various years differ in many instances so that they are not strictly comparable. The only figures used in making the present computations were the basic tables showing tonnages both by product and by industry.

ADJUSTMENT OF DISTRIBUTION TO PRODUCTION DATA

Since the published shipment tables were not comparable in their original form and did not cover the entire industry and since there are no data available on total steel shipments, it seemed best to use the proportions indicated by the shipments to allocate hot-rolled steel production to the ultimate users.[1] Accord-

[1] Practically all the steel products which are shipped may be classified as hot-rolled products or are the result of the further finishing of hot-rolled products.

ingly, the percentage distribution by industry of each class of products for which shipments were reported separately was applied to the appropriate hot-rolled iron and steel production. The resulting series have the advantage of being derived from totals which are comparable from year to year, which represent practically the entire production in the country, and which contain no duplications. It is reasonable to expect that, to the extent that the various shipment figures reported in different years are representative of all shipments, the percentages going to different industries derived from the reported shipments should be adequate for allocating production data to ultimate consuming classes. Production and shipments for any given year are, of course, unlikely to be identical but they are probably not very different. The main discrepancies between them arise from variations in the inventories of finished steel held by steel producers at the end of each year. There are no figures available by which the condition of these inventories can be ascertained, but it seems, from the opinion of various persons concerned with such matters, that relatively little finished steel is customarily stored and the amounts that are kept on hand as stock do not ordinarily change radically from year to year.

INDUSTRY CLASSIFICATIONS

It is probable that the greatest errors inherent in the shipment data arise from inconsistent industry classifications of consumers on the part of the reporting steel companies. Some companies made careful reports of their shipments based on standard systems of customer classification, but at least a few others make rather inadequate ones. Certain companies do not appear to have had or do not now have records suitable for accurately reporting shipments by industry groups. Fortunately, data for these companies that have been reported most incompletely have usually been segregated from the others in the published tables. The trade journals have endeavored to check back on the reports and have asked for recalssifications when they have detected obvious mistakes, but it has been impossible to eliminate all errors. Since the present adjustments have been made for much broader industry groups that those shown in the original published tabulations, it is hoped that many of the misclassifications indicated above do not affect them. The combinations of industry subgroups into the larger classes were made with the advice of the persons on the respective staffs of *Iron Age* and *Steel* responsible for the tabulations. A list of the industry sub-groups is shown in Appendix B.

PRODUCT CLASSIFICATIONS

Relatively few difficulties arose from the product classification, primarily because there has been little variation in the product classes over the entire period, except that in some of the earlier years merchant and concrete bars were combined and galvanized sheets were included with all other sheets. In the adjustment of each published product total, the most nearly comparable hot-rolled production was carefully chosen and the selection of products for these classes was checked with the editors of *Iron Age* and *Steel*. A list of the product classes currently used by *Iron Age* and *Steel* and the group of hot-rolled products related to each class in the computations are shown in Appendix C.

JOBBERS, WAREHOUSES, AND OTHER DISTRIBUTORS

From 15 to 20 percent of the finished steel shipped each year goes to jobbers, warehouses, and other distributors [2] who, in turn, resell the steel to the same types of consumers as those who take their shipments direct from the mill. Because certain products, at least, are distributed through jobbers to the various consuming industries in different proportions from those typical for direct sales, it is desirable to reallocate the jobber shipments to consuming groups. In the absence of any statistical basis, allocations have been made, product by product, on the basis of advice from a number of people familiar with the uses and distribution channels of the various products. The methods employed in these adjustments and reasons for their use are described below.

Since the proportion of rails and track accessories handled by jobbers is insignificant, the actual tonnages reported in all years were, for convenience, assigned to miscellaneous industries. For the most part, the shipment of plates, shapes, merchant bars, black plate for tinning, strip, and all other sheets other than galvanized which are distributed by jobbers appear to go to much the same consuming industries in about the same proportions as do the shipments resulting from mill

[2] For simplicity all types of distributors will be referred to here as jobbers.

sales. Consequently, the jobber tonnages for these products were allocated to the consuming industries in the same proportions as direct sales.

Three product groups, galvanized sheets, pipes and tubes, and wire products, appear to have different distribution patternsn through jobbers than in direct sales. Special inquiries were made concerning the jobber sales of these products and the following methods of allocation were adopted, based on the information collected:

1. Galvanized Sheets:
   - (a) 50% to the construction industry for roofing ventilating, etc.
   - (b) 10% to agriculture for bins, tanks, etc.
   - (c) 40% to miscellaneous industries, including sheet metal shops, air-conditioning, etc.
2. Pipes and Tubes:
   - (a) Total production of line pipe and oil country goods was allocated to the oil, gas, and water industry. Whenever the estimated production of skelp and rounds necessary for conversion to line pipe and oil country goods differed from the tonnage of skelp and rounds allocated to the industry on the basis of the original figures, the difference was adjusted by adding or subtracting the required tonnage from the amount originally allocated to jobbers.
   - (b) The remaining jobber tonnage was split between mechanical tubing and a combined tonnage of standard pipe, boiler tubes, and all other pipe.
   - (c) Mechanical tubing was allocated 40% to automotive, 40% to machinery, and 20% to miscellaneous industries.
   - (d) Other pipe was distributed 50% to construction, 25% to agriculture, and 25% to miscellaneous industries.
3. Wire Products were Allocated:
   - (a) 35% to agriculture.
   - (b) 40% to construction (including repairs).
   - (c) 25% to miscellaneous.

Appendix A. Miscellaneous Notes on Procedure

1. In 1938 both *Iron Age* and *Steel* included railroad buildings and bridges under construction instead of under railroads as was formerly the case. In order to make these classes reasonably consistent with previous years, transfers of plates, shapes, and merchant bars were made to railroads from construction based on the proportions of these products used for railroad buildings and bridges in recent years.

2. All concrete bars handled through jobbers have been transferred to construction in the first adjustments.

3. For 1923, 1924 and 1925 shipments through jobbers reported by *Iron Age* were allocated to industry classes by the compilers.

4. Miscellaneous industries should not be compared through all the years unless furniture and furnishings, etc., are added.

5. Before 1933 the *Iron Age* did not report galvanized sheets separately. For previous years 65% of the jobber tonnage of sheets was allocated as galvanized sheets and the remainder as ordinary sheets.

6. All shipments of plates, shapes, bars and pipes originally allocated to the container industry were transferred to construction.

Appendix B. Industry Sub-Groups Included in Major Consuming Industry Groups

Automotive—Automobiles, trucks, parts, etc. (tractors in some years).

Railroads—Trackwork, cars and locomotives, parts, railroad buildings and bridges.

Agriculture—Implements, equipment, other farm uses, tractors in some years.

Construction—Fabricators, building contractors, concrete reinforcing companies, building hardware and trim companies, concrete bar jobbers, highways, boiler and tank makers, power developments, containers made from heavy steel products.

Shipbuilding—Ships, boats, barges.

Containers light—Made from light steel products, predominantly tin cans.

Machinery—Machinery, hand tools, electrical machinery and equipment.

Oil, gas and water—Oil, gas and water.

Mining, lumbering and quarrying—Mining, lumbering and quarrying.

Furniture and furnishings—Furniture and stove makers, domestic appliances, refrigerators, office equipment.

Miscellaneous—Bolt, nut and rivet makers, forgers, pressed and formed metal manufacturers.

Appendix C. Hot-Rolled Product Combinations Used in Adjusting Iron Age and Steel Shipment Data

Rails—Heavy, light, girder, and high tee.
Track accessories—Long splice bars, tie plate bars, and cross ties.
Structural shapes—Heavy structural shapes and sheet piling.
Plates—Sheared and universal.
Bars—Merchant bars (carbon and alloy) and light shapes.
Concrete bars—Concrete bars, including those rerolled from old material.
Black plate—Black plate for tinning only (combined with strip and strips for tinning in 1938).
Galvanized sheets—Galvanized sheets and galvanized formed products.
Sheets—Hot-rolled sheets minus galvanized sheets and galvanized formed products plus all black plate other than black plate for tinning.
Strip—Strip, hoops, bands, and cotton ties.
Pipes and tube—Skelp and blanks or rounds for piercing.
Wire products—Wire rods.
All other—Rolled forging billets, blooms and billets for export, car wheels and other hot-rolled products.

Exhibit No. 2181

INDEXES OF MILL-NET YIELDS ON PRODUCTS SHIPPED BY UNITED STATES STEEL CORPORATION SUBSIDIARIES

This is an analysis prepared by the Special Economic Research Section of United States Steel Corporation, composed of Messrs. Edward T. Dickinson, Jr., Ernest M. Doblin, H. Gregg Lewis, Jacob L. Mosak, Mandal R. Segal, Dwight B. Yntema and Miss Marion W. Worthing. The work of this group was under the supervision of Theodore O. Yntema, Professor of Statistics, University of Chicago. This analysis was written by Marion W. Worthing and has had the benefit of suggestions from other members of the staff. It is issued by United States Steel Corporation.

November 1, 1939.

Purpose

The purpose of this memorandum is to describe the construction of several index numbers which have been prepared from mill-net yield [1] figures for the major steel products shipped to the domestic market by subsidiary companies of the United States Steel Corporation.[2] These index numbers have been built from different combinations of mill-net yields—the combinations being adapted to the type of analysis for which each was designed. The first section of the memorandum is devoted to a general description of the methods used in constructing the indexes and the reasons for their preparation. In the appendix material, the handling of special problems which arose during the computations is discussed and technical procedures are outlined.

[1] The mill-net yield is the amount of money actually received by the steel company for its products, i. e., the delivered price minus the freight.
[2] Excluding in most instances shipments of the Columbia Steel Company.

The Indexes

In the following paragraphs the indexes which have been constructed are described briefly.

1. GENERAL YEARLY INDEXES

The over-all yearly index was based upon mill-net yields for nearly all the major steel products of the United States Steel Corporation subsidiaries. These major products were then divided into two sub-groups—light and heavy [3]—and a separate index was computed from yields for products in each group. Each of these three yearly indexes was computed by two somewhat different methods.[4] As a result, six separate yearly indexes were prepared which were based on yield data from all the major steel producing subsidiaries. They are shown in Table 1.

2. GENERAL MONTHLY INDEXES

Three indexes were computed on a monthly basis: (a) All products; (b) Heavy products; (c) Light products. These indexes are shown in Tables 2, 3, and 4. The group of indexes referred to here and in paragraph 1 above might be said to represent United States Steel Corporation subsidiaries' mill-net yields in general. To the extent that fluctuations in mill-net yields are representative of fluctuations in delivered prices, these yield series indicate changes in prices.

3. *IRON AGE* INDEX

In Table 5 the *Iron Age* composite price of finished steel has been reduced to index form for purposes of comparison.

Table 1.—*Comparison of Annual Mill-Net Yield Indexes for Mills of United States Steel Corporation Subsidiaries Computed from Yields at Separate Mills and Computed from Average Yields at All Mills, 1920–1938*

[1926=100]

Year	All Products		Heavy Products		Light Products	
	Based on yields at separate mills	Based on average yields for all mills	Based on yields at separate mills	Based on average yields for all mills	Based on yields at separate mills	Based on average yields for all mills
1920	125.4	124.8	123.6	122.7	129.2	129.2
1921	107.9	107.4	105.8	105.2	112.2	112.2
1922	86.0	85.7	82.6	82.2	92.9	92.9
1923	102.7	101.9	102.6	101.6	102.9	102.9
1924	108.1	107.9	108.4	108.2	107.6	107.5
1925	101.1	101.2	101.1	101.3	101.1	101.1
1926	100.0	100.0	100.0	100.0	100.0	100.0
1927	96.5	96.4	97.1	96.9	95.7	95.8
1928	93.6	93.2	95.0	94.3	91.9	92.1
1929	94.9	94.4	96.4	95.9	93.1	92.8
1930	88.3	87.8	89.2	88.7	87.3	86.8
1931	82.0	81.2	82.8	82.0	81.1	80.5
1932	79.4	78.8	81.5	80.8	76.9	76.3
1933	77.2	76.6	80.7	80.0	72.8	72.7
1934	89.5	89.0	90.0	89.6	88.8	88.5
1935	91.2	90.8	92.2	91.8	90.1	89.7
1936	89.1	88.5	90.2	89.6	87.9	87.3
1937	98.8	99.6	101.1	103.0	96.0	95.4
1938	99.8	99.7	102.2	103.6	96.9	95.3

Source: All indexes computed from mill-net yields of major steel products shipped to the domestic market by mills of subsidiary companies of the United States Steel Corporation.

[3] The major products falling into the "heavy" classification are: semi-finished goods, plates, shapes, bars, rails, and pipe. "Light" products include sheet, strip, tin plate, and wire products.
[4] A description of these methods appears in the Appendix.

TABLE 2.—*Monthly Indexes of Mill-Net Yields for Steel Products Shipped to the Domestic Market by Mills of United States Steel Corporation Subsidiaries, 1912–1939*

[Average month of 1926=100]

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1912	57.9	57.3	57.5	57.6	58.1	58.4	58.3	58.9	59.6	60.8	60.9	61.9
1913	63.3	64.3	65.2	65.7	66.0	66.4	66.2	66.1	65.9	65.3	64.2	62.9
1914	61.2	60.8	61.2	61.1	60.6	59.9	59.0	59.2	59.4	59.6	59.5	58.8
1915	58.2	58.0	58.1	58.8	59.1	59.6	60.1	60.4	61.0	62.1	63.1	64.5
1916	67.3	68.7	71.0	74.2	77.3	79.2	82.3	84.0	86.0	88.2	90.8	93.6
1917	98.8	103.5	107.3	111.9	115.4	118.7	123.3	127.5	131.5	134.4	134.2	132.8
1918	139.3	137.6	136.1	135.8	137.9	138.2	139.4	139.5	140.6	142.1	142.6	140.2
1919	136.1	134.7	132.1	125.4	123.9	122.0	121.9	121.5	121.2	121.5	120.8	121.6
1920	122.2	122.2	122.3	123.5	124.0	123.8	124.4	124.8	125.1	126.1	125.8	126.5
1921	126.1	126.5	126.6	118.7	114.6	113.6	106.1	98.7	94.6	90.4	88.1	86.9
1922	85.4	84.7	82.8	82.7	82.9	83.5	84.2	85.1	86.2	87.3	88.6	90.0
1923	91.9	94.1	96.0	98.4	100.4	101.9	103.6	105.1	106.2	107.7	110.4	110.6
1924	112.6	112.7	113.0	112.6	111.0	108.3	107.3	105.3	104.2	102.0	101.4	101.2
1925	101.9	102.3	102.9	103.0	102.3	100.7	100.2	100.3	99.7	99.7	99.5	99.6
1926	99.8	100.0	99.6	100.2	100.1	99.8	99.8	99.5	99.9	99.6	99.9	99.8
1927	98.7	98.0	97.0	96.6	95.9	96.4	96.3	96.3	95.9	94.9	95.2	93.5
1928	93.4	93.4	93.3	93.4	94.3	93.8	92.9	92.4	92.7	92.9	93.9	93.7
1929	94.2	94.2	93.9	94.3	94.2	94.3	95.0	95.4	94.5	94.3	94.3	94.0
1930	92.4	91.6	91.2	89.9	88.9	88.0	86.6	86.0	85.0	83.7	83.3	82.0
1931	82.2	83.2	82.3	81.8	81.4	80.4	79.9	79.8	81.9	80.0	81.3	80.2
1932	78.6	79.1	79.3	78.7	77.7	79.2	79.5	79.3	79.0	78.8	78.2	77.9
1933	77.0	76.0	76.6	75.0	74.5	74.6	73.5	75.0	77.2	79.4	82.6	83.5
1934	87.1	88.1	87.4	87.1	88.5	87.4	91.8	92.9	91.9	93.3	92.5	89.9
1935	92.1	92.0	91.9	91.9	92.0	91.2	90.5	90.8	90.0	89.6	88.8	89.6
1936	89.0	89.1	87.6	86.4	87.1	88.2	87.3	88.1	88.8	89.6	90.0	90.6
1937	91.4	92.3	93.3	95.8	98.0	99.8	101.6	101.9	103.4	105.7	104.8	105.3
1938	105.4	105.1	105.9	104.3	104.4	102.7	97.9	96.2	95.9	93.7	91.6	92.2
1939	93.2	94.1	95.8	95.1	94.8	92.1	91.4	------	------	------	------	------

Source: Computed from mill-net yields for the major steel products shipped to the domestic market by mills of United States Steel Corporation subsidiaries. Complete notes are presented in the text of the memorandum.

TABLE 3.—*Monthly Indexes of Mill-Net Yields for Heavy Steel Products Shipped to the Domestic Market by Mills of United States Steel Corporation Subsidiaries, 1912–1939*

[Average month of 1926=100]

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1912	58.2	57.5	57.6	57.7	58.2	58.9	58.6	59.3	60.3	61.6	61.7	62.7
1913	64.1	65.1	66.0	60.4	67.0	67.1	66.9	67.1	67.2	66.6	65.5	63.8
1914	62.2	61.8	62.3	61.6	60.9	60.3	59.6	59.9	59.8	59.7	59.6	59.1
1915	59.0	58.4	58.3	58.8	59.2	59.6	60.0	60.3	60.9	62.5	63.8	65.3
1916	68.5	69.6	71.8	75.1	78.4	80.6	84.0	85.4	87.9	90.1	93.0	96.4
1917	102.0	105.1	109.3	114.4	118.3	120.6	124.0	128.4	132.9	134.9	134.9	136.3
1918	140.1	137.5	135.0	137.3	138.1	137.8	140.2	140.9	140.3	141.8	141.2	141.0
1919	137.4	135.9	132.5	125.3	122.8	120.7	120.6	119.7	119.0	118.4	117.7	119.0
1920	120.8	121.1	120.6	121.4	122.0	121.8	122.0	122.7	122.8	123.6	123.3	123.2
1921	123.1	123.5	123.8	114.5	111.4	110.7	104.7	97.0	93.1	87.9	85.3	83.0
1922	81.6	81.3	78.9	78.9	79.0	79.5	80.5	81.3	82.4	84.7	85.9	87.5
1923	89.6	92.6	95.1	98.0	100.8	102.6	104.0	105.1	106.1	107.5	109.7	110.7
1924	112.9	113.5	114.1	113.6	111.9	108.8	107.8	105.8	104.5	101.7	100.7	100.1
1925	101.7	102.1	102.3	102.5	102.3	101.1	100.8	101.2	100.5	100.4	100.0	100.2
1926	99.9	99.6	99.2	99.8	99.7	99.8	100.4	100.6	100.4	100.2	100.3	99.3
1927	99.3	99.4	98.5	97.7	97.3	97.3	96.7	96.4	95.3	93.5	93.9	92.4
1928	93.9	94.1	93.5	94.4	95.5	95.0	93.7	93.5	93.8	94.1	95.3	95.0
1929	95.9	95.9	94.8	95.6	95.3	95.5	96.2	97.2	95.8	96.0	95.6	94.7
1930	94.9	94.3	93.4	91.0	90.5	89.1	86.8	85.9	84.9	83.7	83.4	82.3
1931	83.3	84.4	83.3	82.9	82.3	80.8	80.2	80.5	82.0	80.1	81.9	79.9
1932	79.1	80.8	80.8	81.1	79.3	81.0	81.5	81.9	81.2	81.9	81.5	81.1
1933	80.8	79.8	80.3	78.6	77.9	78.1	76.1	73.0	81.4	83.4	85.4	85.8
1934	86.6	88.5	87.7	86.4	89.2	88.4	92.4	94.1	93.3	94.3	94.0	91.3
1935	93.2	93.3	93.0	93.0	93.3	92.3	91.8	91.7	90.9	90.3	89.4	91.1
1936	90.1	90.9	90.1	87.5	87.2	89.7	87.9	88.6	89.9	90.5	90.9	92.1
1937	93.4	93.9	94.8	97.9	99.9	101.5	103.9	104.7	106.2	108.0	106.9	106.9
1938	107.1	107.1	109.0	106.6	106.0	104.5	99.4	97.9	97.4	95.7	96.0	95.6
1939	95.1	96.7	97.5	95.5	96.7	94.9	93.7	------	------	------	------	------

Source: Computed from mill-net yields for the major heavy steel products shipped to the domestic market by mills of United States Steel Corporation subsidiaries. Complete notes are presented in the text of this memorandum.

TABLE 4.—*Monthly Indexes of Mill-Net Yields for Light Steel Products Shipped to the Domestic Market by Mills of United States Steel Corporation Subsidiaries, 1912–1939*

[Average month of 1926=100]

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1912	57.9	57.2	57.9	57.8	58.2	57.9	58.4	58.6	59.0	59.3	59.8	60.6
1913	62.1	63.4	64.1	64.7	64.7	65.2	65.3	64.5	63.8	63.3	62.2	61.6
1914	59.8	59.2	59.6	60.5	60.1	59.5	58.3	58.3	59.1	59.8	59.7	58.5
1915	57.3	57.3	57.9	59.2	59.2	60.0	60.5	60.9	61.3	61.5	62.0	63.4
1916	65.3	67.5	67.8	73.1	75.9	77.0	79.8	81.8	83.1	85.1	87.2	88.7
1917	93.2	101.4	104.3	107.6	110.6	115.7	122.5	126.6	129.8	134.5	133.8	127.1
1918	138.6	138.7	139.0	138.8	138.6	140.0	138.7	137.6	142.2	143.8	146.2	139.4
1919	134.7	133.2	132.2	126.6	126.8	125.6	125.1	125.7	126.2	128.5	127.6	127.4
1920	125.7	125.0	126.5	128.2	128.8	128.5	130.2	129.9	130.5	132.0	131.5	133.6
1921	132.7	133.2	133.0	127.9	121.9	120.2	109.7	102.7	98.1	96.2	94.3	95.0
1922	93.4	92.1	91.1	90.8	91.3	92.1	92.2	93.4	94.2	93.3	94.5	95.6
1923	96.8	97.6	98.5	99.7	100.4	101.1	103.3	105.8	107.0	108.6	112.4	111.2
1924	112.5	111.7	111.3	111.0	109.8	108.0	106.7	105.0	104.0	103.4	103.3	103.7
1925	103.1	103.5	104.8	104.5	102.6	100.5	99.3	99.0	98.8	99.0	99.0	99.3
1926	100.2	101.5	101.1	101.6	101.2	100.3	99.3	98.2	99.3	99.0	99.6	100.7
1927	98.0	96.4	95.2	95.5	94.4	95.3	95.9	96.2	96.9	96.8	96.9	95.1
1928	92.8	92.5	93.1	92.2	93.1	92.5	92.0	91.1	91.5	91.5	92.1	92.3
1929	92.4	92.2	92.8	92.9	92.9	93.1	93.5	93.4	93.1	92.5	92.9	93.3
1930	89.4	88.5	88.8	88.7	87.1	86.8	86.5	86.3	85.2	83.9	83.2	81.9
1931	80.9	81.7	81.2	80.5	80.5	80.0	79.8	79.2	81.8	80.0	80.8	80.6
1932	78.1	77.1	77.5	75.7	75.9	77.1	77.1	76.1	76.5	75.0	74.4	74.1
1933	72.4	71.6	72.3	70.6	70.6	70.3	70.2	71.5	72.0	74.6	79.3	80.8
1934	87.7	87.8	87.2	88.1	87.8	86.5	91.2	91.5	90.4	92.1	90.7	88.3
1935	91.1	90.7	90.8	90.7	90.7	90.1	89.3	89.8	89.1	88.7	88.3	87.7
1936	87.8	87.1	84.7	85.2	87.1	86.6	86.9	87.8	87.8	88.5	88.9	88.8
1937	89.3	90.5	91.4	93.2	95.8	98.0	98.9	98.7	100.1	103.0	102.4	103.5
1938	103.5	102.9	102.4	101.7	102.6	100.8	96.2	94.3	94.2	91.4	86.3	88.3
1939	91.0	91.0	93.9	94.8	92.7	88.8	88.7	-------	-------	-------	-------	------

[1] Source: Computed from mill-net yields for the major light steel products shipped to the domestic market by mills of United States Steel Corporation subsidiaries. Complete notes are presented in the text of this memorandum.

TABLE 5.—*The Iron Age Composite Price of Finished Steel as an Index, 1912–1939*

[Average month of 1926=100]

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1912	61.5	60.5	60.2	61.9	62.9	63.5	65.0	67.1	69.5	71.7	73.4	74.5
1913	76.5	76.3	77.1	77.3	74.6	72.9	72.0	70.2	68.7	67.3	65.0	63.2
1914	62.7	63.8	63.6	62.5	61.5	60.4	60.5	62.5	63.5	62.5	60.3	59.0
1915	59.7	60.3	61.0	62.1	61.9	62.4	63.5	65.3	67.3	70.6	76.4	83.8
1916	89.0	95.2	105.7	112.8	118.8	116.2	114.0	115.9	119.4	123.4	130.5	141.6
1917	146.2	151.2	161.5	177.5	197.1	216.2	230.4	226.7	218.1	149.8	148.8	148.6
1918	153.3	153.3	153.3	153.3	153.3	153.3	153.3	153.3	153.3	153.3	153.3	149.5
1919	145.6	145.6	141.8	130.9	130.5	130.5	130.5	130.5	129.8	131.8	133.2	134.3
1920	152.7	152.7	164.2	170.9	168.0	166.3	169.1	172.7	170.8	162.5	154.2	133.1
1921	129.1	123.1	115.9	114.0	114.5	109.0	102.2	96.0	93.0	91.3	88.8	86.4
1922	84.6	82.2	82.2	85.1	87.7	90.1	91.5	87.0	101.6	103.6	103.3	102.4
1923	103.7	109.5	115.5	119.9	119.7	118.6	118.6	118.6	118.6	118.6	118.6	118.0
1924	118.6	117.5	115.0	112.0	100.2	108.0	105.8	103.5	101.8	101.0	101.6	103.6
1925	104.1	104.6	104.7	102.0	100.6	99.6	99.5	98.7	97.7	98.3	99.8	100.6
1926	100.3	100.0	100.3	100.1	99.5	99.7	100.0	100.0	100.0	100.0	100.0	100.0
1927	98.5	95.9	96.5	96.2	95.7	95.5	95.4	95.4	95.0	93.0	92.1	92.1
1928	92.3	93.7	94.1	94.0	93.0	93.0	92.6	93.3	93.3	93.7	94.2	94.5
1929	94.7	94.7	94.7	96.0	96.2	96.6	96.2	95.6	95.4	94.9	94.7	95.2
1930	93.4	92.8	92.7	90.6	88.8	88.2	87.2	86.3	85.9	85.6	85.4	84.8
1931	85.4	85.6	85.6	85.3	85.3	84.8	84.4	84.0	84.0	84.0	83.8	82.5
1932	81.2	81.1	81.2	82.4	82.4	82.4	82.7	82.7	82.7	82.5	82.0	82.0
1933	81.4	80.9	80.6	78.5	77.8	78.6	81.1	81.3	81.6	84.2	83.5	84.0
1934	84.0	84.0	84.0	85.9	91.5	91.5	88.8	88.8	88.8	88.8	88.8	88.8
1935	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8	89.1	89.1	89.1
1936	89.1	88.1	87.3	87.6	87.6	87.8	90.3	90.3	90.5	91.4	91.4	95.0
1937	97.1	97.1	106.2	108.5	108.5	108.5	108.5	108.5	108.5	108.5	108.5	108.5
1938	108.5	108.5	108.5	108.5	108.3	106.2	39.4	99.4	99.0	97.4	98.7	98.7
1939	98.7	98.7	98.7	98.7	97.5	96.6	96.6	-------	-------	-------	-------	------

Source: Computed from data published in the *Iron Age*, January 5, 1939, p. 199, and from data published in the weekly issues through August, 1939.

General Statistical Methods

At this stage it is in point to discuss the reasons for reducing mill-net yield data to index number form and also the methods by which this may be accomplished.

An index number may be defined as a device for summarizing the fluctuations of a number of individual groups or series of figures. The need for such a summary is indicated in the following discussion. Although mill-net yields from the sale of steel plates, to take an example at random, are important among yields for steel products, the fluctuations in yields for steel plates could not safely be assumed to be indicative of the changes in mill-net yields for steel products in general. The same thing may be said of the yields for any other single steel product. Clearly, some kind of summarization is necessary because a single yield series is not sufficiently comprehensive to be representative of a broad classification of goods. Therefore, in order to have some way of measuring the relative changes in steel mill-net yields in general, it is necessary to analyze either all the individual mill-net yields for all steel products, i. e., plates, structural shapes, rails, sheets, tin plate, etc., or, at least, the mill-net yields for a representative sample of all steel products. But if each of the many groups of yields were to be considered singly, it would be impossible to arrive at any definite conclusions about their movements taken as a whole. Therefore, such groups of figures or series are often combined or averaged into a single series of figures so as to obtain a composite, month by month or year by year, as the case may be, of their movements as a group.

This combined or average series of figures is the basis for an index number. Since the actual numerical value of any item in a combined series has little or no meaning in itself, the members of that series are usually expressed as relatives. That is, one item of the combined series, or an average of several, is selected as a base and its relative is said to be equal to 100; then the other members of the series are expressed as a percent of the base. When the same base is used for an entire series, the series is said to have been related to a fixed base.

Clearly, the mill-net yields of individual products differ in importance depending upon such criteria as the amounts of the different kinds of products usually shipped or upon their value. In averaging the yields used in an index, therefore, it is necessary that each figure be multiplied by an appropriate weighting factor, for in that way the relative effect of the movements of any one of the component series is limited to a predetermined proportion of the whole.

Index numbers are ordinarily described by the method used in making the combinations. The actual methods of construction are various, depending on the kind of average used and the way in which the magnitude of group change is expressed. All of the mill-net yield indexes of which the construction is described in this memorandum are of the general type known as ratios of aggregates. This means that the index number for any month or year was obtained by computing the sum of the products [1] of individual mill-net yields and the corresponding selected weighting factors. The result of this process, called an aggregate, was then divided by a similar aggregate for the selected base period in order to express the aggregate as a relative.[2]

It is usually undesirable to use the same set of weights throughout a long period. With the passing of time, certain products become less important and others more important. Extreme cases of this kind occur whenever a product ceases to be produced or a new one is marketed and becomes important. Furthermore, allowances must be made for changes in the form in which the data are reported. Most of these difficulties can be overcome by using several weighting periods and then chaining the aggregates for these periods into a single series. A weighting period is simply a group of years or months for which the same set of weights is used in computing the aggregates. A different group of weights is determined for each weighting period. Then, in order to make a continuous series, the aggregates for each weighting period are chained together. Chaining is accomplished by computing aggregates for one overlapping month or year. That is, if July, 1926, were selected as the point for chaining, an aggregate for July would be computed as of the original weighting period and another aggregate as of the second one. The original series could then be extended by computing

[1] The word "product" is used here in the mathematical sense. If Y_1, Y_2, Y_3, etc., are yields for a series of products and W_1, W_2, W_3, etc., are their respective weighting factors, the sum of the paired products would be Y_1, multiplied by W_1, plus Y_2 multiplied by W_2, plus (Y_3W_3), etc.

[2] The mathematical formula for this index is:

$$\frac{\Sigma\ (W_kY_1)}{\Sigma\ (W_kY_0)}$$

in which W_k is the weighting factor, Y_0 the mill-net yield for the base period, and Y_1, the mill-net yield for the given period.

the next item—the figure for August—which would be larger or smaller than the July aggregate in the original series in the same proportion that the August figure was larger than the July figure in the second series.

When it becomes necessary to break these series into weighting periods, the breaks should come at points where adjustments can be made for as many as possible of the changes which are bound to creep into the series. Any period may be used as a base for computing relatives in this kind of an index. The actual selection of a particular base depends on what period the maker of the index wishes to emphasize or to consider as normal. The base for any index may be easily shifted to another year or month by dividing all the present index numbers by the index number for the selected year or month.

Data From Which the Indexes Were Computed

1. MILL-NET YIELDS

The basic materials for these indexes were monthly figures on the tonnages shipped and the mill-net selling values of more than 75 classes of steel products.[1] These tonnages and amounts were used to compute average mill-net yields. Roughly 75 per cent of the total tonnage of steel shipped each year by United States Steel Corporation subsidiaries was covered by these figures. Reports from the Carnegie-Illinois Steel Corporation and the National Tube Company were tabulated for individual mills. The American Steel and Wire Company, the American Sheet and Tin Plate Company, and the Tennessee Coal, Iron and Railroad Company, on the other hand, reported on a company basis only. Shipments of the Pacific Coast subsidiary were not included in the computations.

The classes of products which could be used were limited by the form in which records were originally reported and subsequently kept on file by the subsidiary companies. Since the use of all the yield data available would have entailed a great amount of clerical labor, only the most important products, from a tonnage standpoint, and those products made at the most important mills were used. Practically all alloy steels have been excluded from these figures. Details concerning the use of the mill-net yield data in the indexes are included in the Appendix.

2. DATA USED IN PREPARING WEIGHTS

All of the weights were based on tonnage figures reported in the United States Steel Corporation's "Annual Summaries of Domestic Shipments" in which the total tonnages of the various steel products shipped to the domestic market by all United States Steel Corporation subsidiaries are shown. The classes of products reported therein differ in several respects from the classes of products by which the monthly mill-net yield data were reported. In the "Annual Summaries of Domestic Shipments," all steel products are accounted for, but the actual product classes which are used vary considerably from year to year. Although more kinds of products are represented in the annual summaries, the monthly data were usually reported only for certain important subclassifications, the makeup of which tended to be relatively homogeneous. The mechanics involved in computing the weights used in the mill-net yield indexes are described in the Appendix.

Appendix

Notes and explanations relating to special statistical procedures or problems involved in the construction of the indexes are presented in this section of the report.

WEIGHT COMPUTATIONS

Although the products for which mill-net yields were available represent only part of the tonnage actually shipped, the weights used in constructing the indexes were related to almost all of the products shipped. That is, the weights were based not only upon the tonnage shipped of the particular products for which mill-net yields were available, but also upon the tonnages of the other products for which yields were not available in detail. The reason for using all these products in the weighting computations is that it is desirable to give a single component series as much weight as it deserves from a proportional view point. Therefore, if the movements of a given series are not only representative of the particular product, but are also reasonably representative of the movements of another series, it may be used to represent the second series in instances where no yields are obtainable.

[1] Data for the 75 product classes were not, however, all available at any one time.

Furthermore, it should be noted that the more homogeneous are the products included in a single series, the more likely it is that the fluctuations in the mill-net yields are genuine and do not result in part from varying quantities of subclassifications of goods of different qualities.

Several methods were used to determine what products might be most suitably included in a single weight group. The yearly movements of the series for which mill-net yields were reported in the annual shipment summaries were compared with each other in some instances. Whenever the movements of several series were found to be similar, shipments of these products were combined for weighting purposes. In other cases, knowledge of the product or the way it was customarily priced determined into what weighting group its influence should be thrown.

SELECTION OF WEIGHTING PERIODS

The yearly indexes prepared in this study were chained at 1926, and 1936, so that three weighting periods were used 1920–1926, 1926–1936, 1936–1938. The weighting periods used for the monthly series were as follows:

January, 1912—August, 1920
August, 1920—July, 1926
July, 1926—July, 1936
July, 1936—June, 1938
June, 1938—July, 1939

The monthly series were chained in the same years as the yearly series so that their periods would be similar. Before the actual month was selected at which the shift was to be made, monthly aggregates for both series were computed. The month selected for chaining in each case, e. g., July 1926, was one for which the difference between the aggregates of the two series seemed to be about the same as the average for the year.

As a base period for all of these series the aggregate for 1926, or for the average month of 1926, was chosen for several reasons. The year 1926 may be described as one of relatively normal business conditions, i. e., neither a boom nor a depression was in progress. Mill-net yield levels were relatively stable throughout the year. Furthermore, 1926 is often used as the base for year index numbers.

The weights used for the period 1912–1920 inclusive were computed on the basis of shipments during the year 1920. Weights for the other periods were based on average shipments for several years. For the period 1920–1926 the weights were based on 1924, 1925, and 1926 shipments, and those from 1926 through 1936 on average shipments for 1934, 1935, 1936, and 1937. Redistribution of the latter weights to different product classes were made for the 1936–1938 and 1938–1939 periods.

Weights for the 1926–1936 period were based on shipments in the years at the end of the weighting period so that the index would be weighted by a combination of products typical of recent years.[1] The same principle was applied to the 1920–1926 weights. The years 1924–1926 and 1934–1937 were averaged in each case so that the weights would not be greatly influenced by variations in shipments caused by cyclical changes in the volume of business. The selection of 1920 shipments for the purpose of weighting the 1912–1920 period was in accordance with these procedures. The break was made in the series in 1936 because so many new product classifications became available at about that time. It seemed, however, when it came to constructing weights for the 1936–1938 or 1938–1939 periods that the weights computed on the basis of 1934–1937 shipments could not be improved upon. Therefore, the weights for product groups derived from shipments for 1934, 1935, 1936, and 1937 were merely redistributed to the larger number of classifications available in the years 1936–1938. In order to use data for 1939, it was necessary to shift the weights again because of the change in the form in which the data were reported.

COMPUTATION OF TWO GENERAL INDEXES

In an early section of this memorandum it was noted that the general yearly indexes had been computed by two slightly different processes. A description of the methods and reasons for their use follows:

[1] Weighting by quantities sold in years near the end of each weighting period probably results in a slightly lower index than weighting by quantities sold in years near the beginning of each weighting period. This small downward bias tends to offset the small upward bias inherent in some of the mill-net series due to the gradual introduction and growth of higher priced specialty steels in some of the classes of products. This upward bias was kept as low as possible by using only standard products and excluding specialty products from the series used in the index.

In computing the first general yearly index, separate mill-net yields were used for each product at each mill in so far as the data were available in that form. For the products which were reported only on a company basis, the average mill-net yield for the company as a whole had to be used. The weight arrived at for each product was allocated among the mills according to the importance of each mill.

Theoretically, the same plan could have been used in the computation of the monthly indexes, but some practical difficulties interfered. In the first place, some of the monthly series were incomplete, i. e., occasionally no public shipments were made during a month or series of months. Such lapses in the data were naturally frequent among products which are primarily shipped to other plants of the company for further finishing. Also, plants would occasionally be shut down for repair. Gaps in the series could not be ignored in the process of computing the index because the effect of the omission of the amount represented by the mill-net yield multiplied by the appropriate weight would usually be sufficient to cause an unreal movement in the final index. If such breaks in the data were relatively infrequent, it was usually possible to substitute a reasonable figure in the blank, but when the number of months in which no shipments occurred became frequent, there was less justification for substitution and the computation procedure had to be altered.

At the same time, another difficulty arose with respect to the mill-net yield data. So far as it was possible, the individual series were confined to homogeneous product groupings, but in the case of steel product groups homogeneity is only a relative term. Each separate shipment, even though nominally related to the same base price, is subject to different additions and deductions. When the total shipments for any month are very small, the yield for these shipments will not always be representative of the average either for that mill or that general class of products. A substantial variation in the yield for one month brought about by a small tonnage shipped at an abnormally high or low yield can, therefore, cause unwarranted variations in the index.

Because of these two major difficulties which arise from the use of the monthly data at separate mills, it seemed advisable to combine the tonnage figures and the selling values at all the mills for each product and then compute the average mill-net yeild for each product. The monthly indexes from 1920 on were computed from average mill-net yields for all reporting mills.

The general yearly indexes were computed by both of the methods just described. A comparison of the indexes computed by these methods reveals relatively insignificant differences (see Table 1).

THE 1912–1920 MONTHLY INDEXES

The segments of the monthly indexes covering the period January, 1912, to August, 1920, were computed by a modified procedure. The statistical methods employed were identical with those throughout the rest of the series, but the data on which the computations were based were for selected products and selected mills. That is, mill-net yields for an abbreviated list of representative products were weighted on the basis of total shipments for the year 1920. Discussion with respect to combinations of data for groups of products or groups of mills is not applicable, of course, to the 1912–1920 figures.

ADJUSTMENTS OF PRODUCT CLASSIFICATIONS

A further adjustment had to be made in some of the mill-net yields in order to make the data comparable. As it has been stated previously, even a relatively homogeneous product classification may be composed of sub-groups of products some of which could reasonably be reported separately. The result of this situation is that changes in product classifications have often occurred which did not actually involve the addition or deletion of a particular type of product from those shipped. Thus it is, to use a specific example, that the classification "bars, rounds, etc." for a number of years might include, "deformed concrete bars", "bars, rounds, special quality", and "seamless tube rounds" in addition to the products usually described collectively as "bars and rounds." Then the method of reporting shipments would be changed and each of these sub-classifications might be recorded separately. It is plain that after the separation "bars and rounds" would no longer be the same class of products. Therefore, within a single weighting period comparability in the product class for "bars and rounds" was maintained by combining the data for these sub-classifications with the main classification; definite splits in classes were made only with the adoption of a new weighting period.

SUBSTITUTED FIGURES

Even when yearly data were used for computing index numbers, it was necessary in a few instances to fill in a yield for one mill in a blank year. The usual procedure for estimating these yields was to assume that the yield in a given year at that mill would be related to the yield in an adjacent year in the same proportion that similar yields for the same product in a nearby mill were related.

RETURNS

The records of shipments kept at the mills contain deductions for returned goods. In some cases, the entire returned tonnage was subtracted from the tonnage shipped, but only part of the value of the returned shipment was deducted. Ordinarily, the tonnage involved in irregularities of this sort would be relatively small and the effect on the mill-net yield would consequently be insignificant. The result of this practice in the case of coke tin plate, however, was to cause an abnormally high mill-net yield for December, 1938. In order to avoid this variation, a mill-net yield was computed for that month excluding the effect of returned goods.

Exhibit No. 2182

IMPROVED QUALITY OF STEEL AS A PRICE REDUCTION

[This statement was prepared by the United States Steel Corporation in connection with the hearings on the steel industry before the Temporary National Economic Committee.]

November 1, 1939.

A comparison of the price of any steel product ten or fifteen years ago with the price of the product known by the same name today gives an incomplete and inaccurate impression, as it does not take into account the many substantial economies which buyers of steel have been able to effect by reason of its improved quality. These improvements have not, in general, been compensated for by price increases, and have, therefore, amounted to price reductions. So great have these improvements in quality been, that in some cases it is misleading even to call the products by the same name.

Many people who are unfamiliar with steel may think of it as a single product, of different sizes and shapes, but of more or less uniform quality. This may have been relatively true in the early days when customers had to adjust their needs to the limitations of steel. Today, however, there is no such product as common steel, but, instead, practically all steel is "custom made" to conform to the special requirements of each buyer. The ability to obtain steel perfectly suited to their requirements has enabled manufacturers to take advantage of modern methods of production to effect reductions in their costs and to design new models which could not have been produced with the steel of former years.

The automobile is an outstanding example of the custom made character of steel. In the 1939 model of one of the leading automobiles there are no less than 32 distinctly different types of steel, each specially made to order and designed, by chemical content or special treatment, to meet the particular requirements of the part for which it is to be used. The steel specifications for a given part, for different makes of automobiles are usually different.

Reductions in real price through quality improvements, which are found in almost all types of steel products, are illustrated by the following examples in each of the principal general types of steel products.

Sheet Steel

The average base price of steel sheets used in making automobile bodies has been reduced approximately 30% in the last fifteen years, despite the fact that during this period all of their service properties have been tremendously improved.

The modern sheets, made by a radically new method of processing, can be produced 33⅓% thinner and 20% wider than was possible fifteen years ago and can now be made in coils hundreds of feet long as compared with a former maximum length of 100 inches. The deep drawing qualities have been increased 30% to 40% permitting deeper stamping of much more sharply rounded shapes. Deep drawing qualities of common sheets although limited and inferior formerly

entailed an extra charge. Today there is no extra charge for the truly remarkable drawing properties of automobile sheets.

The modern one-piece automobile steel top is stamped out in one operation from a single sheet of steel. Formerly, it was necessary to make the top of wood and fabric entailing numerous hand operations.

A front fender can now be stamped out of one sheet in the same way in one operation. It was formerly made of two sheets of steel separately formed and then joined together.

Painting the surface of the earlier automobile sheets to develop an acceptable finish required elaborate preparation, glazing, and many separate coats with intermediate treatment between each two coats. Today these operations are unnecessary, because of the fine grain and dense polished surface of modern sheet steel. As a result, the time required to apply the finish to a part has been reduced from a minimum of 48 hours to 6 hours. The following photomicrographs, (pp. 14111–14112) of a 1939 and of a 1924 type of sheet, made in 1939 by 1924 methods, show clearly the improved surface.

Enameled articles, such as electric refrigerators, sinks and bathtubs, made of sheet steel are stamped into shape and enameled. Improvements in the modern steel enameling sheets have permitted the manufacture of deeply formed modern designs of these products, with a nearly perfect and non-chipping enamel finish impossible a few years ago. Despite these cost saving improvements, the base price of steel enameling sheets has been reduced approximately 30% in the last fifteen years.

The present day high quality silicon steel sheets used in the electrical industry have made possible more efficient generation and use of electrical energy and thus contribute significantly to the use of larger generators and motors than were used fifteen years ago. The resulting savings are well illustrated by reduction in the losses of electric power in the steel cores of generators from .77 watts per pound in 1924 to .52 watts per pound in 1939, an improvement of about 32½%. These improved sheets are sold at substantially the same price as the corresponding sheets fifteen years ago.

Tin Plate

Approximately 50% of all tin plate sold today is so-called "cold reduced" tin plate. This new and improved type, introduced in quantity about 1931, is sold at a lower price than the hot rolled tin plate of 1924.

The improved workability and resistance to corrosion of cold reduced tin plate, which could not have been obtained by 1924 methods, have been important factors in the canning industry. Its high corrosion resistance has made it possible to can prunes and some types of cherries which could not be canned successfully with hot rolled tin plate. Cans containing other types of acid fruits which could not be kept longer than eighteen months without risk of becoming unsalable, can now be kept as long as seven years. Its improved workability has materially facilitated fabrication.

All modern tin plate has a much more uniform coating of tin due in part to improved smoothness in the surface of the black plate on which the tin is applied. This improved surface, which is important in all uses of tin plate, is illustrated by the following photomicrographs (p. 14113).

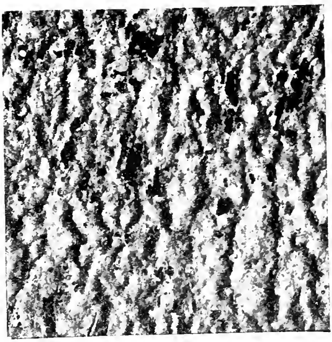
The purchaser of modern tin plate has less waste in trimming the sheets to the size and shape required for his purposes since modern tin plate is much more accurate in its dimensions than was the tin plate of fifteen years ago. Increased uniformity of thickness has contributed to the economical use of high speed machines with automatic feeders in the can-making industry, by eliminating the necessity of frequent adjustments in the machines and has also resulted in a reduction in sheet damage.

It is estimated that, due to the improved quality of modern tin plate, the average weight of tin plate used for any given purpose has decreased about 10%, which, at present prices, would mean a reduction of about 20 cents per base box.

Formerly, a relatively high number of sheets of the tin plate were damaged in transit to the purchaser's plant due to twisted and bent edges. The modern, much more compact and better protected packages, made possible by the almost perfect uniformity of the sheets, have greatly reduced these losses.

In 1936 the United States Steel Corporation developed and introduced a new lower priced type of tin plate, electrolytically plated, called "Ferrostan". It is being used to replace the more expensive tin plate in cans for baking powder, coffee and similar "dry packs" and has made possible the economical packaging of various additional commodities for convenient distribution.

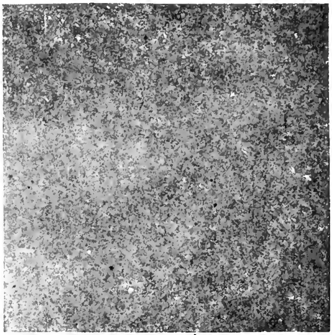
1939 SHEET—UNPAINTED



1924 SHEET—UNPAINTED

(Magnification 16-2/3×)

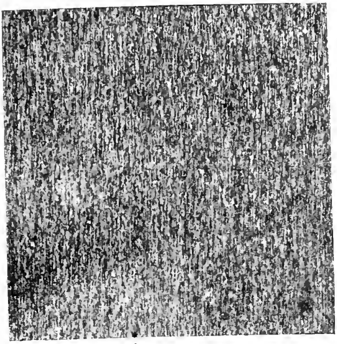
1924 SHEET—SPRAY-PAINTED BY SAME METHOD AS 1939 SHEET



1939 SHEET—SPRAY-PAINTED BY USUAL 1939 METHOD

(Magnification 16-$\frac{2}{3}$×)

1923 Black Plate



1939 Cold Reduced Black Plate

(Magnification 16-⅔×)

In 1933 the United States Steel Corporation developed and introduced a light coated terne plate as a substitute for tin plate at a substantially reduced price. Although never used where the surface would be in contact with food, since its coating contains a substantial amount of lead, it has been extensively used in cans for paint, varnish and oil.

Structural Steel

The use of an improved series of beams, known as wide flange beams, developed in their modern efficient form during the last twelve to thirteen years, has permitted the following estimated construction savings:

Higher tier buildings	20%
Lower tier buildings and heaviest mill buildings	15%
Short bridges where wide flange beams are substituted for built up girders	15% to 20%
Large bridges and light mill buildings	5% to 10%

Bulkheads, seawalls and similar retaining walls can now be built of modern improved steel sheet piling more than twice as strong as was possible with the steel sheet piling of five or six years ago. Despite its doubled strength, this improved piling, known as Z piling, costs only 7% more per square foot than the best section available five or six years ago. Before the introduction of Z piling, in order to obtain equivalent strength it was necessary to reinforce and strengthen the older type of section, involving additional steel and increased fabrication costs.

A new type of steel foundation pile, introduced in 1935, has made possible savings ranging from 10% to 40% over competitive forms of construction for bridges, buildings and other structures, and has made possible the reclamation of many building sites.

In 1934 the United States Steel Corporation introduced a new type of steel bridge floor for use with concrete or asphalt but weighing less than the reinforced concrete then used. This has been a great step toward more economical bridge building, since the weight of the bridge flooring, and not that of the traffic, which is always light by comparison, determines the size of the foundations and superstructure. Its lighter weight makes possible lighter and less expensive foundations and superstructures in new bridges, and has often extended the useful life of old bridges. It has also been used to increase the load carrying capacity of old bridges with only minor, inexpensive changes or additions to the existing structure. Under favorable conditions, it costs no more than reinforced concrete slabs.

Late in 1937, an all steel, open lattice-work type of floor, for use without concrete or asphalt, was introduced. Its exceedingly light weight makes it particularly fitted for the lifting spans of draw bridges and its open lattice-work character makes it very useful in states where snow removal is a problem. Though it costs approximately twice as much as reinforced concrete slabs, it permits more than offsetting economies, in machinery and power required for the lifting of draw bridges, and in reduced maintenance and snow removal costs.

One or the other of these types of floors has already been used in nearly 500 old or new bridges, including its use in New York City in reflooring three main bridges and flooring one new bridge.

Stainless Steel

Stainless steel, although only introduced on a large scale during the last ten years, has already replaced other types of steel and other competitive products in many uses where ability to withstand high temperatures or resistance to corrosion is a factor. It has considerably reduced upkeep and replacement costs when it has been used, because of its long life due to its high strength and corrosion resistance, and because its hard, permanently bright surface does not require repeated painting and is not worn away by scouring.

Stainless steel has been quite generally adopted in the dairy industry for vessels, pipes and other pasteurizing and bottling equipment. It has been found to be the outstanding commercial metal completely insoluble in milk cooling from the pasteurizing temperature and its surface can easily be kept clean and sanitary. It has been extensively used recently in the construction of tank trucks for carrying milk.

It has also been extensively used in the food processing and packing industries, for reasons of hygiene and economy. It has been installed in the pineapple canning plants in Hawaii, as it has proven to be the only commercial metal which successfully resists the action of pineapple juice.

Enamel and glass ware equipment, considered a great step forward when introduced in the dairy, food processing and packing industries, have now been largely replaced by stainless steel because their great weight and fragility made transportation costly and repairing impracticable.

Due to its resistance to corrosion and its high strength relative to its weight, it has gained a constantly wider and more varied use in the building industry generally, for such parts as doors, hinges, window moldings and restaurant counters. It is particularly adapted for the making of pipes and tubes for use in the chemical industry and in other industries employing equipment subject to severe corrosive influences.

Modern drums of stainless steel are now replacing wooden barrels in the shipment of beverages and syrups, furnishing extra strength, durability and perfect protection of the contents. The ability to cleanse completely the inside of such containers is making it possible to use the same containers almost indefinitely.

Current developments indicate the possibility of adopting extremely thin and strong stainless steel strip for use in airplane wings and bodies, permitting welding instead of riveting, thereby reducing wind resistance and improving operating efficiency.

Although its initial cost per unit weight is somewhat higher than that of the products which it has replaced, its increasingly wide use has been due to the fact that the initial cost has been more than offset by the subsequent reduction in expense of upkeep and replacement and by the lighter weights required because of its higher strength.

Alloy Steels

The science of predicting and controlling the properties of alloy steels which will result from "heat treating" has made very great progress in the last fifteen and even in the last five years. By heat-treatment is meant the modification of properties through the agency of heating the steel to a fairly high temperature and applying thereafter a controlled cooling rate (as in quenching) and a reheating if desired. The steel itself, however, must fit the heat-treatment and vice-versa. It is now possible to predict and control such properties as hardness, toughness or resiliency with a remarkable accuracy, absolutely unknown fifteen years ago.

This is very important in all mass production industries, such as in the automobile industry, where it is common to heat treat parts made of alloy steel. Modern manufacturing methods in these industries are based upon the fact that alloy steels of given specifications, though made at different mills, at different times and under varying conditions, when heat treated in the routine of production will have standard properties.

The inability to predict these properties accurately made it necessary, formerly, to provide for a comparatively wide margin of safety through the use of excess weight or extra alloy content. Equal or superior efficiency can now be obtained by the use of lighter weight parts made of less expensive steel with a lower alloy content.

A reduction of 15% to 20% in the average weight of automobile transmission gears, for example, has resulted from these improvements and analogous weight reductions of varying degrees, have been made in the many other parts made of alloy steel, without sacrifice of service value.

Alloy steels are generally sold in the form of bars to manufacturers, who usually forge, cut and machine them into the desired part and then heat treat them to provide varying degrees and types of properties. It was, until recently, considered almost impossible to control the depth to which steel would harden when heat treated. As a result a relatively brittle core to a part was often unavoidable in obtaining a surface of the required hardness. Steel can now be produced which, when heat-treated, will have the desired hardness on the wearing surface and a far lesser degree of hardness in the center, thus reducing the brittleness and prolonging the life of the part.

The ability to control the size of the small crystals or grains of which steel is composed has also had a distinct share in the improvement of alloy steels as different size grains produce different properties. No technology of grain control existed even twelve years ago.

The greater refinement in the properties of alloy steels has increased the number of standard alloy steels listed by a leading producer from 39 in 1924 to 168 in 1938. This has obviously given the users of these steels far greater latitude of choice in selecting the steel best fitted to their needs.

Although in general the prices of alloy steels have been substantially reduced since 1924, the large number of standard types makes it impractical to indicate

the exact measure of price change in each. However, as examples, the price of two common types has been reduced approximately 15% and the price of two other common types has been reduced approximately 11%.

High Tensile Strength Steels

Great savings have been effected by the railroads through the use of a new type of steel developed by the United States Steel Corporation and commercially introduced in 1934 under the trade name of COR-TEN.

By the end of 1938, there were in service 19,249 freight cars and over 1,000 passenger cars made in whole or in part of COR-TEN. COR-TEN has a yield point 50% to 100% higher than plain carbon structural steel, combined with four to six times its resistance to atmospheric corrosion. It is possible, therefore, to build railroad cars of this material at a substantial weight reduction without decreased strength or durability.

It is possible to construct freight cars made of COR-TEN weighing from 10% to 22% less than cars of conventional construction made of plain carbon steel with all the subsequent operating economies which this reduction in weight entails. Despite its improved properties, the cost of a COR-TEN freight car has been found to be no greater than that of the conventional carbon steel freight car when full advantage is taken of the superior properties of COR-TEN to effect weight reductions.

Even if the cost of a freight car made of COR-TEN were greater than the cost of a corresponding car made of plain carbon steel, the operating economies resulting from its use are so important that its widespread use would be economically justified.

It is estimated that it costs $18 a year to haul a ton of weight over an average annual operating mileage of 11,000 miles per car. The average reduction of 2.4 tons in dead weight in each of these 19,249 freight cars, due to the use of COR-TEN, has therefore resulted in an annual average saving to the railroads of approximately $43.20 per car, a total saving of approximately $830,000 per year throughout the life of these cars. If the saving is considered in terms of additional carrying capacity, each of these freight cars, if loaded to the limit, has an added annual revenue-paying capacity of 2.4 tons. Over an annual operating mileage of 11,000 miles per car, this represents a carrying capacity of 26,400 ton-miles more than that of a conventional car built of plain carbon steel. The 19,249 COR-TEN freight cars can, therefore, be said to have provided a total additional annual revenue-paying capacity of 508,173,600 ton-miles.

The experience of railroads in effecting such economies through the use of COR-TEN has led to its increasingly wide use in many other industries with attendant large savings to the users.

The performance of this material has resulted in the development of other similar and competitive steels.

Steel Pipe and Tubes

The service qualities of all steel pipe and tube have, in general, greatly increased since 1924. A few typical examples of the type of improvement are sufficient to indicate this progress.

One of the chief beneficiaries of the improvements in steel pipe and tubes has been the oil industry. By the use of new seamless oil well casing pipe and oil well drill pipe with numerous new types of special threaded joints, it is now possible to drill wells to depths of approximately three miles as opposed to the maximum depth of 5,000 feet in 1924.

In order to suspend lengths of casing pipe as long as 13,000 feet and weighing up to 300,000 pounds, it has become necessary to produce steels with tensile strengths up to 125,000 pounds and with resistance to external pressure up to 10,000 pounds.

Drilling such deep wells makes necessary a string of drill pipe weighing up to 200,000 pounds which is hung in tension and rotated at speeds varying from 100 to 400 revolutions per minute. This pipe is therefore subjected to tensile stress from hanging, torsional stress from the rotary movement, and alternate bending stresses at the tool joints.

The deep drilling made possible by these improved types of casing and drill pipe has permitted successful redrilling at deeper levels of oil fields, notably in California, which had been abandoned for failure to produce at the former maximum drilling depth, and has also opened up new reservoirs of oil in Texas, Louisiana and Colorado.

In modern oil refining plants, highly alloyed seamless steel tubes, with from 10,000 to 60,000 hours of useful life, have replaced tubes which rarely lasted more than 2,000 to 6,000 hours. Today, it is possible to design tubular apparatus for use in refining to carry unit stresses between 10,000 and 25,000 pounds at 1,000° F., greatly increasing the safety factor in operation and making an enormous saving in weight of equipment.

Improvements in the steam boiler industry have been largely associated with improvements in boiler tubes, superheater tubes and steam pipe through which steam is conveyed. In 1924, due to the fact that the industry was limited to the use of low carbon steel boiler plate and tubes, few steam plants operated at pressures above 500 pounds and at steam temperatures above 700° F. Through the use of modern seamless boiler tubes of alloy steel, boilers are now constructed for pressures up to 2,500 pounds and temperatures of 1,000° F. These tubes will resist the most severe oxidation and corrosion which boiler service conditions impose.

All of these increases in quality have been effected with a lowering of price to the public, except that boiler tubes have increased in price because of the extra cost necessary to produce the very great increase in quality required for high temperatures and high pressures which were totally unknown fifteen years ago.

Rails

Railroad engineers fully appreciate that the railroads are now receiving rails substantially improved in quality and dependability. Although, within the last 15 years, the speeds of passenger and freight trains have increased, on the average, approximately 70% and 55%, respectively, and wheel loads have increased between 40% and 80%, it is the consensus of opinion, among producers and buyers of rails, that the modern rail will last longer, wear better and result in fewer failures in service than the rails produced 15 or 20 years ago. The price is approximately the same.

In considering the price of rails, it should always be borne in mind that even so-called worn out rails are sold by the railroads as prime scrap. The average monthly price of this type of scrap at Pittsburgh for the period 1924–1938 was $14.30 a ton or 34% of the average monthly price of rails during that period. At present the price of old rails as scrap ranges from $22 to $25 a ton, or approximately 60% of the present price of rails.

Lower material, labor and upkeep costs have resulted from increasing the standard length of rails from 33 feet to 39 feet at no increase in price despite the fact that changes in length or weight entail comprehensive and costly changes in steel works and rolling mill equipment. Some railroads order 45 foot rails and serious consideration is being given to the advisability of using rails up to 100 feet or more in length.

The increased dependability of modern rails is due to the improved quality of the steel as verified by increasingly severe testing and inspection standards.

Formerly one specimen of rail from each of the 25 to 30 ingots in each heat were tested by dropping a 2,000 pound wedge shaped steel weight on the top of each specimen from heights ranging from 17 feet for the lightest rails to 20 feet for the heaviest rails. Recently the maximum height of drop was increased to 22 feet. If all specimens passed this test, one specimen was broken and its interior structure examined. If any specimen failed to pass these tests, the top rail in each ingot was classified for less severe service and placed in a lower price category.

Some railroads now require that a specimen from each ingot be subjected to both tests (i. e.. drop test and fracture inspection) and that, if on examination of the test fracture, a specimen is rejected, other tests be made from specimens cut progressively from the rails of that ingot. Under the requirements of this progressive test, rails failing to meet the test are not accepted even as lower priced rails but are rejected and scrapped.

Each of these tests is supervised by separate inspectors representing the rail producer and the railroad. The examination of the cross section of the rail and its approval or rejection is, in many cases, a matter of judgment with respect to which the railroad inspectors have, as a practical matter, fairly arbitrary powers. The requirements of this test and the standards of straightness and smoothness have become so exacting, that rails, which would have been considered good average rails fifteen or twenty years ago and completely acceptable, are rejected today by both the mill engineers and the railroad inspectors.

Special treatments have recently been devised and introduced which appear to remove one cause for one of the most troublesome types of rail failures, known as the "transverse fissure". This is a separation of the metal inside the head of the

rail developed by flexure in service and is not apparent until failure of the rail. The gradual introduction since 1932 of rails subjected to one or the other of these special thermal treatments has remarkably reduced failures due to transverse fissures. The figures of the American Railway Engineering Association indicate that in rails rolled during the five years 1932–1936 there were only 9 such failures in the first year of service as compared with 343 such failures in the first year of service in rails rolled during 1927–1931.

One of the treatments against transverse fissures, the Brunorizing process, developed and introduced by United States Steel Corporation, produces rails which are also much more resistant to shock at low temperatures, an important safety factor in parts of the country where the rails must stand much zero or sub-zero weather.

The increased inspection and control in the rail mills in the making of the steel in the open hearth furnace, in the rolling and in the cooling and other special requirements in connection with rail making have all increased the manufacturing costs of rails and, contrary to the general trend, more men are required to operate a rail mill today, than fifteen or twenty years ago

Wire Products

Improvements in wire products have been due in part to the increased perfection of rods from which wire is made, resulting from scientific selection of ores, classification of raw materials and other improvements in steel making. Improved modern wire making machinery and practices have also contributed to this improvement. Typical illustrations from a few of the numerous wire products are sufficient to indicate the general improvement in quality.

The resiliency of spring wire, for example, has generally increased in the order of magnitude of 50%. Resistance to fatigue, due to repeated flexing, as in the case of springs used in automobile engines, has been greatly increased, thereby prolonging the life of the spring. Although the price of spring wire has been reduced since 1924, it is estimated that its reliability and service has increased from 100% to 500%, depending upon the type of wire.

The uniformity in size, form and physical properties of nails, rivets, bolts and other similar products, requiring the forming of a head by pressure exerted on the end of the wire at high speed has greatly improved due to the improved quality of the wire and wire bars from which they are made. Today practically perfect heads are produced, while formerly irregularities in the wire resulted in considerable irregularity in the shapes of heads which caused failures in service.

The uniformity of nail wire is such that since 1928 it has been a standard requirement that the number of nails per pound must not vary beyond 5% of the standard number. As any slight variation in the thickness of the wire would cause considerable variation in the number of nails, such a narrow limit of variation was formerly impossible. The importance of this is obvious to a buyer of nails who buys nails by weight. Likewise, the increased accuracy in the gauge of wire is extremely important to the purchaser of wire by weight.

The life of galvanized wire has been greatly increased through the improved quality of the galvanizing. It is now a standard requirement that such wire must bend around its own diameter without roughening the galvanized coating, a requirement which could not have been met commercially a few years ago.

It is probable that few people realize the important part wire has played in the development of the modern automobile tire. Nevertheless, the bead of automobile tires has for many years been strengthened by the use of wire. Improved methods in the manufacture of wire have resulted in the production of wire for this purpose having a tensile strength of approximately 300,000 pounds per square inch, which is from 25% to 50% higher than the tensile strength of wire used 10 to 20 years ago. In addition, this wire is now required to meet physical tests for toughness, such as torsion and elongation, both before and after it is subjected to the vulcanizing process. These improved physical properties have permitted a reduction in the size and number of wires necessary for strengthening the tires and have also materially contributed to the increased life and dependability of modern tires.

General Improvement in Quality

In general, the quality of the steel used in all steel products today is far more uniform and dependable and better suited to the needs of the users than fifteen years ago due to general improvements in steelmaking.

The basic materials from which pig iron is made are now selected and graded for uniformity which makes a much superior and more uniform iron.

Chemical control of practically all processes, other than the strictly mechanical, has become universal. Pyrometry for the measurement and control of temperatures has been developed and applied in all important processes.

Slag control in the open hearth furnaces has permitted the production of the several kinds of steels for various uses with a dependability and an accuracy that was not even approximated several years ago.

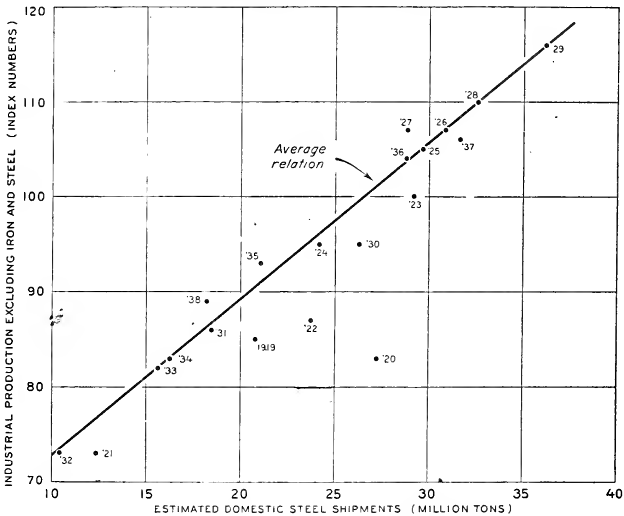
The increasingly greater approach to laboratory standards of precision and quality in the commercial production of millions of tons of steel every year, has required the training and maintenance of a large staff of metallurgical engineers, upon whom practical operating men have necessarily come to rely more and more in the turning out of a modern marketable product.

In short, during the last fifteen years, steel making has been changed from an art to a science with the resulting general improvement in all steels and with accompanying benefits to the users of steel.

Exhibit No. 2183

Fig.

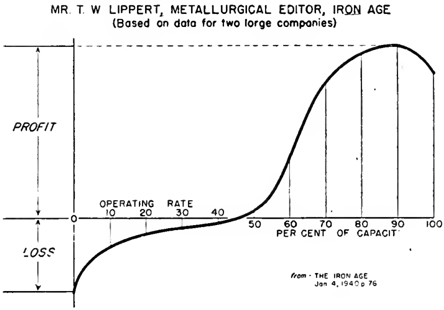
RELATION OF INDUSTRIAL PRODUCTION, EXCLUDING IRON AND STEEL, TO STEEL SALES



U S DEPARTMENT OF AGRICULTURE NEG 35986 BUREAU OF AGRICULTURAL ECONOMICS

EXHIBIT No. 2184

CONTRAST IN PRODUCTION-PROFIT COMPUTATIONS



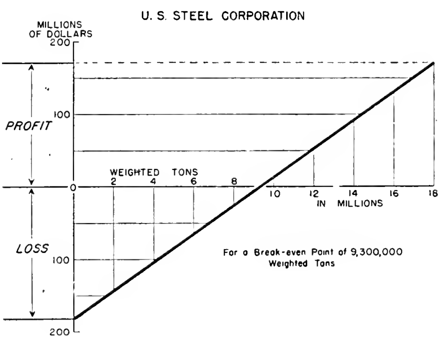


Exhibit No. 2185

Table I.—*Reconciliation of Total Costs Before Bond Interest and Inter-Company Items in "Analysis" and Registration Statement, 1935–37—U. S. Steel Corporation*

	1937	1936	1935
Cost before Bond Interest and Inter-Company Items as per "Analysis (Table 5, columns (2) (3) & (4)":			
Total	$1, 269, 290, 658	$1, 035, 070, 809	$770, 713, 718
Operating Costs	1, 269, 970, 378	1, 035, 128, 989	769, 564, 100
Idle Plant Expense	1, 136, 149	1, 396, 989	2, 089, 259
Purchase Discount	−1, 815, 869	−1, 455, 169	−939, 641
Break-down of Total Costs as per Registration Statement:			
Total	1, 269, 290, 658	1, 035, 070, 809	770, 713, 718
General administrative and selling expenses	44, 668, 352	39, 447, 790	34, 613, 494
Payments under pension plan to U. S. Steel and Carnegie Pension Fund	7, 380, 254	7, 642, 026	7, 362, 723
Taxes (other than Federal income and surtax)	45, 132, 333	37, 220, 467	34, 541, 519
Taxes (state and Federal social security and railroad retirement)	13, 415, 904	4, 081, 587	
Idle plant expenses	1, 136, 149	1, 396, 989	2, 089, 259
Depreciation and depletion	59, 589, 159	55, 466, 762	47, 801, 390
Plant and Organization survey expenses	1, 756, 776	1, 379, 829	285, 003
Discount on Purchases	−1, 815, 869	−1, 455, 169	−939, 641
Reversal of provisions under Railroad Retirement Act of 1935	−744, 729		
Cost of goods sold, operating expenses of transportation common carriers and miscellaneous operations	1, 098, 772, 329	889, 890, 528	644, 959, 971

Sources: "Exhibit No. 1416" and Registration Statement (Form A-2) submitted to the Securities and Exchange Commission.

Table II.—*Comparison of Break-Down of Lumped Costs in the "Analysis" and in Registration Statement, 1935–37* [1]*—U. S. Steel Corporation*

	1937	1936	1935
Breakdown of Lumped Costs as per "Analysis":			
Total	$1, 143, 773, 008	$929, 880, 828	$680, 858, 276
Payroll	426, 330, 944	328, 070, 724	246, 508, 043
Other Expenses	343, 494, 434	293, 599, 768	197, 911, 220
Inter-Company Items	373, 947, 630	308, 210, 336	236, 439, 013
Breakdown of Lumped Costs as per Registration Statement:			
Total	1, 143, 773, 008	929, 880, 828	680, 858, 276
General administrative and selling expenses	44, 668, 352	39, 447, 790	34, 613, 494
Plant and Organization survey expenses	1, 756, 776	1, 379, 829	285, 003
Idle Plant Expenses	1, 136, 149	1, 396, 989	2, 089, 259
Discount on Purchases	−1, 815, 969	−1, 455, 169	−939, 641
Reversal of provisions under Railroad Retirement Act of 1935	−744, 729		
Maintenance and repairs (including provisions for blast furnace relining, oven wall relining and rebuilding and sundry other maintenance reserves)	110, 294, 824	85, 589, 705	59, 097, 850
Depreciation, depletion and amortizing of fixed assets (credited directly to property plant and equipment)	7, 650, 787	5, 492, 640	2, 809, 295
Rents and Royalties	10, 213, 951	7, 860, 403	5, 249, 623
Additions to Reserves Charged to Cost of Goods Sold, Etc.—Total [2]	16, 892, 758	17, 461, 037	14, 010, 938
Residual [2]	953, 720, 009	772, 707, 604	563, 642, 455

[1] "Lump costs" is used to designate the total "other Expenses," "Payroll," and "Inter-Company Items" in the "Analysis." It is the same as total costs less taxes, depreciation, pensions and bond interest (specifically segregated items in the "Analysis," Table 8), all before deducting inter-company items.

[2] There may be some duplication between reserve additions and maintenance and repair items. The effect of such duplication would be to lower the residual.

TABLE II-A.—*Additions to Reserves Charged to Cost of Goods Sold, Etc., 1935–37*[1]—*U. S. Steel Corporation*

	1937	1936	1935
Total	$16,892,758	$17,461,037	$14,010,938
General contingent reserves currently provided by charges to operations and held for purposes arising from operating activities	9,036,960	9,658,240	7,228,531
Accident and hospital reserves currently provided through charges to operations and held to cover expenditures resulting from operating casualties	4,463,981	3,879,490	3,780,359
Reserves raised by current accruals for purposes of absorbing extraordinary expenses in specified operations	273,525	1,247,012	1,071,976
Other reserves provided and held for specific purposes or for other general contingencies for which they may be available	930,016	791,799	503,125
Insurance reserves[2]	1,048,068	1,361,740	826,642
Reserves for sundry marketable securities	527	−184	23,840
Reserves for doubtful notes and accounts receivable	396,168	489,773	309,563
Inventory valuation reserves	730,814	219,256	−89
Reserve for U. S. Steel Corp. stock for employes' subscription			−9,970
Reserves account outside real estate, real estate mortgages and investment in sundry securities	43,244	−46,170	149,764
Reserves account house and land sales installment contracts and mortgages under employes' home owning plans	−645	−55,734	55,566
Reserves for accounts and notes receivable not collectible within one year and other delayed items	−29,900	−84,185	71,631

[1] Detail for "Additions to Reserves" item of Table II.
[2] Provided by charges to operation, together with accretions thereon, are available for absorbing fire, windstorm and part of the marine losses of subsidiaries. The subsidiaries are self-insurers against such losses and generally do not insure with outside insurance companies. Specific funds have not been segregated for these reserves.

TABLE III.—*Taxes Other Than Federal Income and Social Security Taxes, 1927–38—U. S. Steel Corporation*

Year	Total Charged to Costs as per "Analysis"	Capital Stock Tax	Total Excluding Capital Stock	Lake Superior Iron Ore Properties	All Other Properties	Excise and Miscellaneous	Difference[1]
1927	$34,817,116		$34,817,116				
1928	36,015,942		36,015,942				
1929	37,739,322		37,739,322				
1930	36,047,026		36,047,026				
1931	33,162,707		33,162,707	[2] $14,215,551	[2] $19,858,097	[3] $93,984	−$1,004,925
1932	31,943,315	[4] $499,184	31,444,131	12,681,884	[5] 18,950,835	[3] 105,617	−294,205
1933	33,288,485	999,184	32,289,301	[6] 12,735,967	[6] 17,599,925	[3] 288,591	+1,664,818
1934	32,615,831	1,632,508	30,983,323	13,859,408	17,399,374	[3] 289,094	−564,553
1935	34,691,330	[7] 1,736,371	32,954,959	13,828,911	18,604,455	480,272	+41,321
1936	37,999,606	1,808,764	36,190,842	15,137,324	20,209,831	407,906	+385,781
1937	45,132,333	1,929,005	43,203,328	18,197,478	24,685,087	320,763	
1938	34,602,915	2,000,025	32,602,890	12,837,735	19,207,090	558,066	

[1] Difference between accrued tax liabilities and amounts charged to costs. Breakdowns in 1932–36 Annual Reports show accrued liabilities for taxes; Reports for other years show actual charges to costs.
[2] As shown in 1932 Annual Report; no breakdown given in 1931 Report.
[3] Approximate amount.
[4] Allocated to 1932 although paid under the National Industrial Recovery Act which became effective in June 1933.
[5] As shown in 1933 Annual Report. 1932 Report shows $19,087,813 for other than Lake Superior Iron Ore Properties.
[6] As shown in 1934 Annual Report; 1933 Report shows $13,314,519 for Iron Ore properties and $17,869,925 for other properties.
[7] As shown in 1936 report; 1935 report shows $1,759,922.

Source: Break-down from Annual Reports.

TABLE IV.—*Taxes Other Than Federal Income and Social Security Taxes, 1927–1938—Recomputed "Fixed" and "Variable" Costs—U. S. Steel Corporation*

	Estimate of "Fixed" Cost per year	Estimate of "Variable" Cost per Ton	r=
As per "Analysis"	$24, 217, 000	$1. 433	.96
Including 1937:			
Total	29, 950, 000	0. 691	
Capital Stock Taxes (1938)	2, 000, 000		
Other	27, 950, 000	0. 691	.714
Excluding 1937:			
Total	31, 090, 000	0. 514	
Capital Stock Taxes (1938)	2, 000, 000		
Other [1]	29, 090, 000	0. 514	.788

[1] This relation approximates the one for 1927–31 shown in Chart 2. p. 13 of the "Analysis."

Source: Based upon Annual Reports and "Analysis."

TABLE V.—*Maintenance and Repairs, 1927–38* [1]*— U. S. Steel Corporation*

Year	Charges to Costs				Credits to Reserve	Charges to Costs in Excess of Expenditures [2]	Weighted Tons of Products Shipped (Millions)
	TOTAL		From Current Expen.				
	Including Railroads	Excluding Railroads	Railroads	Other			
1927	$113, 875, 264	$91, 035, 161	$22, 840, 103	$85, 526, 894	$5, 508, 267	$138, 779	13. 0
1928	106, 684, 913	85, 707, 302	20, 977, 611	79, 786, 103	5, 921, 199	3, 537, 366	14. 0
1929	107, 235, 214	85, 900, 446	21, 334, 768	79, 411, 147	6, 489, 299	1, 799, 966	15. 1
1930	96, 512, 158	75, 411, 765	21, 100, 393	70, 192, 384	5, 219, 381	1, 139, 119	11. 9
1931	60, 419, 408	46, 338, 658	14, 080, 750	43, 300, 477	3, 038, 181	1, 189, 027	8. 1
1932	29, 112, 622	21, 924, 794	7, 187, 828	20, 628, 709	1, 296, 085	836, 990	4. 4
1933	40, 169, 688	31, 889, 956	8, 279, 732	30, 135, 807	1, 754, 149	962, 941	6. 2
1934	52, 894, 512	40, 974, 798	11, 919, 714	39, 183, 029	1, 791, 769	974, 492	6. 1
1935	59, 978, 426	47, 567, 594	12, 410, 832	45, 447, 619	2, 119, 975	1, 567, 591	7. 6
1936	86, 126, 667	70, 378, 860	15, 747, 807	67, 262, 759	3, 116, 101	720, 599	11. 0
1937	111, 304, 054				3, 621, 175	−122, 234	13. 2
1938	64, 448, 926				2, 100, 825	1, 342, 580	7. 8

[1] Includes a portion of idle plant expenses.
[2] Expenditures excluding extraordinary replacements charged to depreciation and replacement reserves.

Source: Annual Reports, except weighted tons which are from "Analysis."

TABLE VI.—*Stripping and Development Expenses, 1927–38—U. S. Steel Corporation*

Year	Charged to Costs	Charged to Costs in Excess of Expenditures	Weighted Tons of Products Shipped (Millions)	Year	Charged to Costs	Charged to Costs in Excess of Expenditures	Weighted Tons of Products Shipped (Millions)
1927	$4, 431, 341	−$1, 085, 560	13. 0	1933	$2, 103, 857	$1, 006, 073	6. 2
1928	5, 073, 511	599, 479	14. 0	1934	2, 382, 389	953, 003	6. 1
1929	6, 218, 468	1, 713, 361	15. 1	1935	2, 698, 050	1, 421, 606	7. 6
1930	5, 224, 575	−949, 275	11. 9	1936	5, 431, 607	3, 291, 631	11. 0
1931	2, 963, 640	−152, 656	8. 1	1937	7, 557, 125	5, 290, 267	13. 2
1932	482, 575	−797, 763	4. 4	1938	2, 622, 525	477, 360	7. 8

Source: Annual Reports, except for weighted tons which is from the "Analysis."

EXHIBIT No. 2186

PRICE OF TIN PLATE AND OF CANNED GOODS

EXHIBIT No. 2187

THE NET REGRESSION OF VOLUME ON PRICE

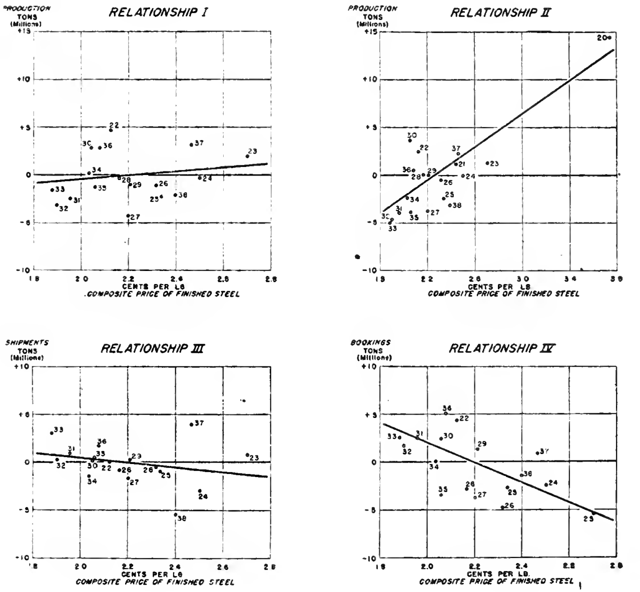
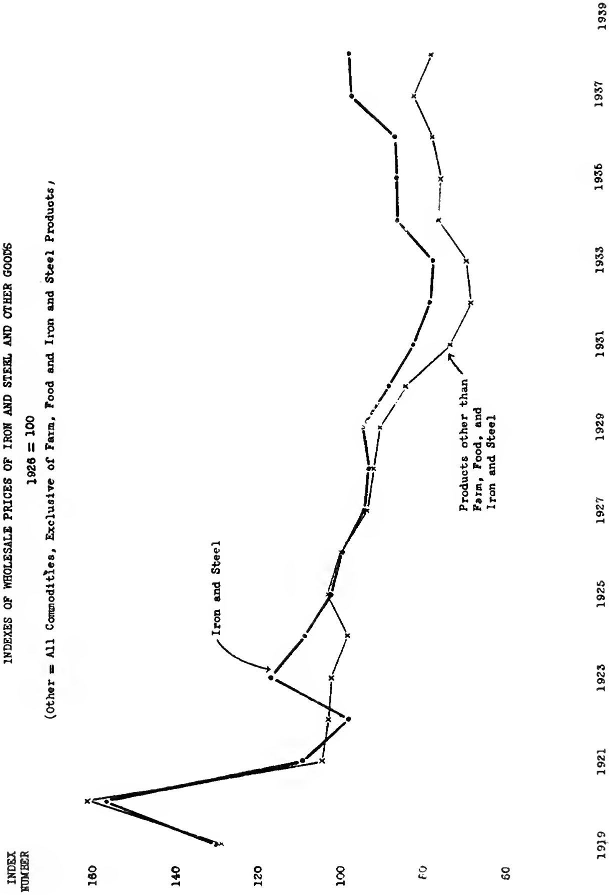


EXHIBIT No. 2188

INDEXES OF WHOLESALE PRICES OF IRON AND STEEL AND OTHER GOODS

1926 = 100

(Other = All Commodities, Exclusive of Farm, Food and Iron and Steel Products)



SUPPLEMENTAL DATA

The following telegrams have no connection with subjects dealt with in this volume; they are included in the record to authenticate certain statements made by Mr. Eugene Orvis in his prepared statement, admitted to the record as "Exhibit No. 1293" and included in Hearings, Part 16, appendix, p. 9330.

[Telegram]

KANSAS CITY, MO., *October 10, 1939.*

JAMES BRACKETT,
Secretary, Temporary National Economic Committee,
Federal Trade Commission Building, Washington, D. C.:

We have been advised that the committee desires certain information from Great Lakes Pipe Line Co. relative to the prepared statement presented at the oil-industry hearing by Eugene L. Orvis. The owners of Great Lakes Pipe Line Co. are Continental Oil Co., Midcontinent Petroleum Corporation, Skelly Oil Co., The Texas Corporation, The Pure Oil Co., Sinclair Refining Co., Cities Service Oil Co., and Phillips Petroleum Co. The members of the traffic committee of Great Lakes Pipe Line Co. and the company by which each is employed are C. A. L. Walker, with Great Lakes Pipe Line Co.; Charles Ervin, with the Texas Corporation; Henry Hauseman, with the Pure Oil Co.; C. A. Holmes, with Cities Service Oil Co.; P. H. Kuins, with Continental Oil Co.; C. R. Musgrave, with Phillips Petroleum Co.; J. M. ODay, with Sinclair Refining Co.; H. W. Roe, with Midcontinent Petroleum Corporation: and A. F. Winn, with the Skelly Oil Co.

This traffic committee is an advisory group whose purpose is to assist the pipe-line management to correlate the cumbersome pipe-line operation with the requirements of all shippers and the regulations of the Interstate Commerce Commission. The recommendations of the committee are in no wise binding upon the pipe-line management or upon any member of the committee nor may any shipping representative speak for the pipe-line company. We have examined the minutes of the traffic committee of Great Lakes Pipe Line Co. and they do not contain the paragraphs quoted by Mr. Orvis on page 10 and continuing to the top of page 11 of his prepared statement; however, the matters appearing in the purported minutes were discussed on several occasions with the traffic managers of the shipping companies prior to item 60 on page 13 of Mr. Orvis' prepared statement being incorporated in the tariffs of the pipe-line company.

The quotation at the bottom of page 21 and extending over to the top of page 22 of Mr. Orvis' prepared statement purports to be an excerpt from the minutes of a meeting held June 23, 1938, of officials of the companies owning Great Lakes Pipe Line Co. No such meeting was held. The quotation is an excerpt from a letter written by the traffic manager of the pipe-line company to the traffic managers of the various shipping companies.

HARRY MORELAND,
Vice President, Great Lakes Pipe Line Co.

[Telegram]

KANSAS CITY, MO., *October 10, 1939.*

JAMES BRACKETT,
Secretary, Temporary National Economic Committee,
Federal Trade Commission Building, Washington, D. C.

Further referring to my telegram to you dated October 9, the paragraphs quoted by Mr. Orvis on page 10 and continuing to the top of page 11 of his prepared statement are not a part of the minutes of the traffic committee of Great Lakes Pipe Line Co. but are undoubtedly a memorandum expressing the views of the

traffic committee on the subjects therein referred to and as stated in my earlier telegram were taken into consideration in drafting item 60 of Great Lakes Pipe Line Co. tariffs which is correctly quoted on page 13 of Mr. Orvis' prepared statement. The copy of a letter which you have dated January 22, 1937, transmitting the minutes of the meeting of the traffic committee of Great Lakes Pipe Line Co. held at Kansas City, Mo., January 19, 1937, is correct. The minutes as attached thereto are also correct except that the heading of the third paragraph on the first page of said minutes referring to Messrs. Kuhns, Okay Winn, and Stewart should read "Members absent" instead of "Members present." The excerpt which you have of the minutes of the meeting of the traffic committee held at Kansas City, October 9, 1936, is correct; however, the reference to case 2610 attached to this excerpt is not attached to the recorded minutes of the committee.

The reference to case 2610, however, is undoubtedly to the proposed rate of 6.9 referred to in the excerpt. The copy of letter which you have dated January 22, 1937, signed by C. A. L. Walker, referring to W. T. L. application D-37-175 to Messrs. Kuhns and others is correct. We have been unable to find in the files of Great Lakes Pipe Line Co. copy of the letter purported to have been written by C. A. L. Walker to R. E. Stewart, dated May 11, 1937; or by Mr. Walker to Continental Oil Co. and other oil companies, dated May 22, 1937; or by R. E. Stewart to Mr. Walker and others, dated May 7, 1937; however, we have no reason to doubt the correctness of the copies of these three letters which you have, and are not questioning their authenticity. We desire to add that the question of whether the intrastate railroad or interstate railroad rate is applicable from the terminals of the pipe-line company is a legal question and the determination of that question has no connection with the published rates of the pipe-line company which appear in its tariffs.

HARRY MORELAND,
Vice President, Great Lakes Pipe Line Co.

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